FIELD SAMPLING PLAN

PORTAGE CREEK AREA REMOVAL
KALAMAZOO, MICHIGAN

Prepared for:

U.S. Environmental Protection Agency
Region 5

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ACRONYMS AND ABBREVIATIONS

%	percent
°C	degrees Celsius
µ	micron
Ag	silver
AR	air
As	arsenic
Ba	barium
bgs	below ground surface
Cd	cadmium
Cr	chromium
CY	cubic yards
EFF	effluent
EQ	Environmental Quality Management, Inc.
FD	Field Duplicate
FSP	Field Sampling Plan
ft	feet
GAC	granular activated carbon
Gl	glass
H_2SO_4	sulfuric acid
Hg	mercury
ID	identification
IDW	investigation derived waste
in	inches
INF	influent
mg	milligram
mg/kg	milligram per kilogram
MDEQ	Michigan Department of Environmental Quality
ml	milliliter
MI	Michigan
MID	between GAC
mm	millimeter
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NIOSH	National Institute for Occupational Safety and Health
No.	number
NTU	Nephelometric Turbidity Unit
OU	Operable Unit
oz	ounce
Pb	lead

Acronyms and Abbreviations – continued

PCBs	polychlorinated biphenyls
Pl	plastic
PPE	personal protective equipment
ppm	parts per million
PVC	poly vinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RBSLs	Risk Based Screening Levels
RCRA	Resource Conservation and Recovery Act
RRD	Remediation and Redevelopment Division
SA	Slope Area
Se	selenium
sf	square foot
SD	sediment
SM	Standard Methods for the Examination of Water and Wastewater
SO	soil
SOP	standard operating procedure
SRD	Substantive Requirement Document
SU	Sample Unit
SVOC	semivolatile organic compound
SW	surface water
TAL	target analyte list
TBD	to be determined
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TCRA	Time Critical Removal Action
TSCA	Toxic Substances Control Act
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WP	Work Plan
WM	wide mouth
WW	wastewater

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1 INTRODUCTION

This Field Sampling Plan (FSP) for the Time Critical Removal Action (TCRA) of contaminated sediment from Portage Creek, a portion of Operable Unit 5 (OU5) of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (Superfund Site) will be implemented according to the project schedule presented in the Work Plan (WP). Portage Creek Site location and applicable work areas are presented in ***Figures 1*** and ***2***. The purpose of the TCRA for the Portage Creek Removal effort is to remove the existing polychlorinated biphenyls (PCBs) in soils and sediments of the Portage Creek from Alcott Street to the confluence with the Kalamazoo River in Kalamazoo, Michigan (MI).

The section of the Portage Creek Area targeted for action has been divided into 10 distinct Removal Areas within 7 designated Slope Areas (SA1 - SA7) of Portage Creek. Slope Areas are designated by the changes in elevation differences, or slope, of the Portage Creek stream bed. The 10 targeted removal areas will be referred to as SA1-A, SA1-B, SA1-C, SA3-A, SA5-A, SA5-C, Axtell Creek, SA5-D, SA6, and SA7. The Removal Areas are presented in ***Figure 2***. It is anticipated that the work will span two to four construction seasons subject to funding allocations and available working budget. Therefore, as detailed in this overview the project will be divided into four phases with the phases divided up based on approximate equal removal volumes for completion of distinct removal areas. The phases may be split over multiple construction seasons if available budget and working conditions permit completion of individual removal areas.

Phase 1 Overview- Construction activities will begin when the final design has been completed and approved by USEPA and necessary access is obtained. It is estimated that preparation activities in Removal Areas SA7, and SA 6 including mobilization and setup of the equipment, materials, personnel, and facilities necessary to complete the project, will begin in late summer of 2011. Preparation activities will include building access roads and staging areas, clearing and grubbing vegetation, pre-removal surveying and installing temporary soil and sedimentation control measures. Excavation of SA7 and dredging of SA 6 are currently expected to be carried out in the fall of 2011 during the Phase 1 construction season.

Excavation of SA6 and SA7 will result in a combined removal of an estimated 3,234 cubic yards (CY) consisting of approximately 159 CY of Toxic Substances Control Act (TSCA) waste [sediments/soils exhibiting PCB concentration ≥ 50 milligrams per kilograms (mg/kg)] and 3,075 CY Subtitle D waste [sediments/soils exhibiting PCB concentrations <50 mg/kg (ppm)]. Note that based on data gap sampling prior to the start of excavation these waste volumes are subject to change.

Phase 2 Overview-To avoid the challenge, including safety hazards associated with winter work in southwest Michigan, active work will shut down over the winter months and resume in the spring of 2012, dependent on water levels within the creek. Phase 2 will include excavation within Removal Areas SA5-D, and Axtell Creek. Phase 2 is expected to be completed in the second construction season during the spring and summer of 2012. Excavation of SA5-D and Axtell Creek will result in a combined removal of an estimated 5,200 CY consisting of approximately 1,530 CY of TSCA waste and 3,670 CY Subtitle D waste. Based on data gap sampling prior to the start of excavation these waste volumes are subject to change.

Phase 3 Overview- Phase 3 will include excavation within Removal Areas SA5-C, and SA5-A. Phase 3 is expected to be completed in the third construction season during the spring and summer of 2013. Excavation of SA5-C and SA5-A will result in a combined removal of an estimated 4,126 CY consisting of approximately 2,394 CY of TSCA waste and 1,727 CY Subtitle D waste.

Phase 4 Overview- Phase 4 will include excavation within Removal Areas SA3-A, and SA1-C, SA1-B, and SA1-A and relocation of the staging pad and water treatment facilities. Phase 4 is expected to be completed in the fourth construction season during the spring and summer of 2014. Excavation of SA3-A, SA1-C, SA1-B, and SA1-A will result in a combined removal of an estimated 4,149 CY consisting of approximately 590 CY of TSCA waste and 3,559 CY Subtitle D waste.

Sediment and Soil Removal Operations- Sediment removal in the creek channels will be accomplished by first isolating the excavation areas upstream and downstream with the installation of sheet pile cofferdams. Bypass pumping around the isolated excavation area and discharging downstream of the excavation area will take place from the time the cofferdams are installed to when the cofferdams are removed following stream bank restoration and creek channel backfilling. Isolation area dewatering will be performed to facilitate “dredging-in-the-dry” and backfill/stream bank restoration. Standing water from within the excavation area will be pumped with appropriate sized centrifugal pump(s), and then either sumps will be installed to remove saturated water from sediments with centrifugal pumps or sipper well points will be driven and connected to a manifold system from removal with vacuum pumps. Water collected from isolation dewatering will be transferred via pipeline (to be constructed) to the waste water treatment system constructed to support site operations. During all excavation activities, erosion controls, re-suspension controls, and water collection and treatment systems will be used to reduce potential impacts to water quality. The spatial extent of all removal activities will be confirmed against design objectives and regulatory requirements using confirmatory sampling, physical surveys, and other techniques summarized in the EQ *Erosion and Sedimentation Control Plan*, August 2011.

Removal activities for each phase will include the following steps:

- Characterize removal grids to confirm removal depths, as necessary.
- Prepare temporary staging areas and access roads, as necessary.
- Remove PCB contaminated soil and sediment.
- Water collection from isolation dewatering and subsequent water treatment.
- Transport and dispose of stabilized sediments.
- Sampling, analysis, data validation, and reporting.
- Site Restoration.

This FSP addresses all sampling activities to be conducted as part of this project.

2 FIELD SAMPLING ACTIVITIES

2.1 Rationale

The potential for eroding banks and creek channel bottom in the area of Portage Creek from Alcott Street to its confluence with the Kalamazoo River may serve as a source of PCBs to the Kalamazoo River. This TCRA has been designed to address the removal and stabilization of targeted creek sediments and floodplain soils in the Portage Creek Area using the *Plainwell No. 2 Dam Area Time-Critical Removal Action Final Design Report* (TCRA Design Report, ARCADIS BBL July 2007) as a model. Sampling and analysis activities will be performed for pre- and post-construction conditions, waste characterization, wastewater treatment, personnel and area monitoring, water quality monitoring, pre-removal PCB concentrations and post-excavation soil and sediment conditions.

2.2 Sampling Requirements

In order to remove the PCB hazard identified in the *TCRA Design Report ARCADIS BBL July 2007,* sampling associated with the removal action will be required. Tasks will include:

1. Characterize removal grids to confirm removal depths, as necessary.
2. Prepare temporary staging areas and access roads, as necessary.
3. Remove PCB contaminated soil and sediment.
4. Collection of water from isolation dewatering and decontamination followed by subsequent water treatment.
5. Transport and dispose of stabilized sediments.
6. Confirmation sediment sampling, analysis, data validation, and reporting.
7. Site Restoration.

Sampling activities associated with each of the tasks listed above include the following:

1. Sampling of sediments in targeted area grids to further characterize PCB concentrations at specified depths.
2. Perform pre-construction sampling of support areas (staging areas, wastewater treatment system location and command post area).

3. During removal of PCB contaminated soil and sediment work area monitoring will include the following:
    a. Water quality monitoring
    b. Personnel monitoring
    c. Area monitoring
4. Water collected from isolation dewatering and decontamination will be treated by an on-site water treatment system. Performance sampling and required discharge sampling of the treatment system will be performed in accordance with a MI Substantive Required Document (SRD).
5. Waste characterization sampling and analysis of stabilized soils and sediments will be performed for each slope area targeted for removal.
6. After all targeted sediment and soils have been removed confirmation sampling will be performed.
7. Site Restoration.

Table 1 presents the sampling scheme for this project.

2.2.1 Pre-Removal Sediment Sampling

To further characterize PCB concentrations in area grids lacking data pre-removal sampling of targeted grids will be performed. This sampling is intended to confirm sediment removal depths. Sediment sampling will be accomplished by wading into the stream, traveling upstream to the targeted grid area, pushing Lexan tubes to the targeted depths and extracting the sediment cores. Additional soil sampling may be performed to characterize PCB concentration of bank areas. Removal Grids that will be sampled are presented in ***Figure 3*** to ***Figure 9***.

2.2.2 Waste Characterization Sediment Sampling

In order to comply with disposal facility requirements waste characterization of targeted sediments that are to be removed will be performed prior to removal activities. In order to properly dispose of stabilized sediment removed from the targeted areas two separate disposal facilities will be utilized. Stabilized sediment removed from areas exhibiting PCB concentration ≥ 50 mg/kg will be disposed of in a facility permitted to received TSCA waste and sediments with PCB concentrations <50 mg/kg will be disposed of in a Subtitle D facility. To complete the profile prior to shipment analysis for waste characterization is required to be completed for each waste stream. This will be accomplished by taking separate composite samples of sediment or

TABLE 1. SAMPLING SCHEME

Location	Matrix	Purpose	Number of Samples /SU	Total Number of SU	SU Locations	Total Number of Samples[2]	Sampling Method
Targeted Grids from each Slope Area	Sediment and soil	confirm sediment removal depth	2-5	26	See Figures 3 to 9	110-113	sediment/soil core composite
Targeted Removal Area	Sediment and soil	waste characterization	4	2-3	9	TBD	sediment/soil core composite
Upjohn Park	soil	extent of contamination	1	12-20	TBD	TBD	surface grab
Construction Area	soil	pre-construction & post-construction conditions	6	1/2500 sf	Support Areas[3]	TBD	surface soil composite
Source Material	solids	confirm backfill is clean prior to placement	1	1/5000 cy	TBD	TBD	composite
Turbidity Monitoring Stations	surface water	water quality monitoring	1	3	200 ft upstream, 200 ft and 300 ft downstream	1 measurement each location every 30 minutes	Real Time Measurements - Turbidity
Turbidity Monitoring Stations	surface water	water quality monitoring	1	2	200 ft upstream, 200 ft and 300 ft downstream	2	grab
Personnel Workers within exclusion zone	air	personnel monitoring	1	1 worker	breathing zone of workers in removal/staging areas	TBD	NIOSH 5503
Work Area	air	area monitoring	5	1	2 locations upwind, 3 locations downwind of work area	multiple	real time measurement – DataRam
Perimeter Monitoring	air	confirm no release of contaminants from work areas	1	5	2 locations upwind, 3 locations downwind of removal area	5/day for each day of processing activities	NIOSH 5503
Wastewater treatment	waste water	confirm removal of contaminants prior to discharge	1	3	influent, mid-GAC, effluent	3	grab
Removal Grid Areas	sediment	Confirm removal of PCB contaminated sediment	6	72	See Figures 3 to 9	72	sediment core composite
Removal Grid Areas	sediment	statistical analysis of project objectives	6	8	TBD	48	grab

Notes:
1. SU – sampling unit such as a slope area removal grid or each 2500 sf of construction areas.
2. Does not include QC samples.
3. Command Post, dewatering/staging areas, waste water treatment plant, truck wash.
4. TBD – to be determined, sf – square foot, cy – cubic yards

soils from each Slope Area targeted for removal from sediments/soils expected to be ≥ 50 mg/kg and <50 mg/kg. One or more samples of each disposal waste stream will be taken from each targeted area.

2.2.3 Upjohn Park Soil Sampling

In order to determine the potential of PCB contaminated sediment deposited in the Upjohn Park area biased sampling will be performed in targeted areas. Sample selections will be made based on potential deposition as a result of historical flooding of Portage Creek. This will include low lying areas, areas where visible sediment is observed or other areas identified to be of potential concern. Surface soil grabs will be taken and analyzed for PCBs. The location of Upjohn Park is presented in ***Figure 2***.

2.2.4 Pre- and Post-Construction Soil Sampling

Pre-construction conditions will be characterized by sampling surface soils prior to constructing dewatering pads, establishing the command post area, and constructing the on-site waste water treatment system. Composite samples for PCB analysis will be taken in these areas at a rate of 1 composite sample per 2500 square feet (sf) and additional sample parameters every 10,000 sf in support areas as defined in Section 2.3.3. Post-construction conditions will be evaluated by sampling these areas after all support material and equipment have been removed. Post-construction sampling will be performed in the same manner as Pre-Construction sampling. ***Figure 10*** presents the proposed sample locations for the main staging area located at E. Crosstown Parkway and John Street. ***Figure 11*** and ***Figure 12*** present the support areas for SA6 and SA7, respectively.

2.2.5 Borrow Source Material Sampling

Prior to using any borrow source material in restoration or grading activities it will be sampled to ensure clean fill materials are used. Samples will be taken at a rate of one sample per 5000 CY of each type of material excluding river run rock which will be sampled at its original source area. Composite samples will be submitted to the laboratory for analysis. Analytical results will be compared to applicable Part 201 cleanup criteria and Part 213 risk-based screening levels provided in the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division (RRD) Operation Memorandum No. 1 (Table 2, Column #19, *Direct Contact Criteria & RBSLs*), issued by the RRD of the MDEQ on December 10, 2004. If exceedances are reported, that source area will not be used to provide backfill and the material will not be used.

2.2.6 Water Quality Monitoring

During removal of PCB contaminated soil and sediment work water quality monitoring, will be performed. Water quality monitoring will include real time monitoring and surface water sampling.

2.2.6.1 Turbidity Monitoring

Real time, direct-read turbidity readings will be collected daily during excavation activities to identify construction-related contributions, if any, to existing creek turbidity levels. Real time turbidity monitoring will be performed with stations set 300 ft upstream, 200 ft downstream, 300 ft downstream of cofferdams set at each area. Turbidity monitoring will not be performed in SA7, as the removal activities are isolated to the floodplain. Turbidity monitoring will be recorded on half hour intervals by a programmed data logger at the turbidity station. Other readings may be collected based on field conditions such as presence of visible runoff to the creek in the work vicinity, or as part of mitigation measures. Data will be transferred to a computer in the EQ command post trailer via a cellular modem.

Real time turbidity measurements designed to monitor resuspension control systems will be supplemented by inspections of the control systems. Inspections will be conducted each day at the beginning of activities. Inspections will also be conducted, as appropriate, in response to visible sediment plumes migrating from the work area or measured turbidity levels above the action level. If warranted additional inspections may be conducted following higher-flow periods, noticeable turbidity increase outside the system, unexpected system position/behavior, contact with the system by equipment or debris, or other abnormal events.

Mitigation measures may be taken based on the turbidity data obtained. If the downstream turbidity data are two times (2x) the concurrent upstream data, specific steps will be initiated until the exceedance has been mitigated to below the action level (AL). Note that the measurements made at the location 200 ft downstream of the work area will be used as an early warning of potential exceedances, and the measurement mad at the location 300 ft downstream of the work area will be compared against the AL. The latter will trigger the mitigation measures presented in ***Figure 13*** and summarized below, until the exceedance has been mitigated.

The first mitigation measure implemented in response to the second 30 minute reading which exceeds the AL will be an observation of the area downstream of the work area to determine whether distinct sediment plumes or other characteristics that may indicated the cause of increase turbidity are visible.

- If a sediment plume is visible, its point of origin will be identified through an inspection of the resuspension control system.
    - In the event the resuspension control system is not functioning correctly or is damaged, excavation removal activities will be suspended until any necessary repair or adjustments have been completed.
- If no suspended sediment plume is visible, the submerged turbidity meter will be inspected for damage, malfunction, improper calibration, or other localized condition that may cause or mimic an elevated turbidity reading. A reference reading will be taken using a hand held turbidity meter.
    - If the submerged meter is damaged or improperly calibrated, a replacement unit will be used until the original unit has been repaired and/or calibrated, and returned to service or until a new calibrated unit has been deployed.
    - If the submerged meter is functioning properly, an inspection of the resuspension control system will be conducted, and any necessary repairs or modifications will be implemented.

The rate and/or method of removal activities will be adjusted if it is determined that the AL exceedance is a result of work activities and the resuspension control system appears to be functional based on inspection. Note this will apply to work areas where turbidity curtains are used as the primary control system, not sheet pile cofferdam control systems.

- The removal rate will be reduced (as much as 25%), the location will be adjusted, or other modifications will be made, as deemed necessary, and the impact on turbidity levels will be assessed for 1 hour.

- If turbidity has not been reduced to below the action level after 1 hour, the sediment removal rate will be reduced (as much as 50%), or other modifications will be made, as deemed necessary, and the impact on turbidity levels will be assessed for 1 hour.
- If this second adjustment is unsuccessful at lowering turbidity to below the action level, excavation activities will be suspended until acceptable turbidity levels have been achieved.

For cases where it is necessary to reduce the rate of, or cease excavation activities, excavation activities may be resumed (at previous rates) once turbidity readings have been below the action level for 30 minutes, provided that mitigation measures have been completed and unacceptable turbidity levels have not occurred. ***Table 2*** provides a summary of the resuspension monitoring.

2.2.6.2 Surface Water Sampling

Surface water samples will be taken weekly at the upstream and 300 ft downstream location and submitted to the lab for PCBs, total suspended solids (TSS) and phosphorus. Reporting limits and associated methods are presented in the QAPP.

2.2.7 Personnel Monitoring

Baseline/periodic personnel monitoring will be performed by taking personnel samples of workers in the removal and/or the stabilization area during removal activities. Samples will be submitted to the laboratory for PCBs. Reporting limits and associated methods are presented in the QAPP.

2.2.8 Area Sampling

Area monitoring will include real time monitoring for particulates using a DataRam in the removal areas and staging pad areas. Monitoring will be performed during active removal operations and stabilization of removed sediments. Monitoring will be performed at the start of site operations and at a minimum of every four hours during removal and stabilization activities. Additional monitoring will be performed as necessary.

Perimeter monitoring will be performed around stabilization activities. A minimum of 5 locations will be selected staging and processing areas to ensure upwind and downwind locations of the work area are monitored for any potential release of contaminants. Samples will be taken for total particulates and PCBs as described in section 2.3.7.

TABLE 2. RESUSPENSION MONITORING

Activity	Location	Location /Type	Parameter	Frequency	Metric
Water Monitoring	200 ft upstream of work area; 300 ft downstream of work area	Grab sample	PCBs TSS Phosphorus	Weekly (phosphorus – monthly)	N/A
Routine Turbidity Monitoring	200 ft upstream of work area; 200 and 300 ft respectively, downstream of work area	Turbidity probe at turbidity station	Turbidity (NTU)	Instantaneous readings conducted at 30 minute intervals	2x of concurrent upstream value
Supplemental Turbidity Monitoring	Within and outside the resuspension control system as necessary to identify and correct potential problems with the system	Visual surface inspection	Turbidity (NTU)	As required to diagnose potential source of metric exceedance	N/A
Verification that resuspension control system is properly installed	Entire resuspension control system	Visual surface inspection	Integrity, proper function	Once prior to initiation of work at a given work area and as required in the event of any major repair or modification of the resuspension control system	If integrity or function appears compromised, repairs or modifications will be implemented as necessary
Routine resuspension control system inspections during sediment removal work periods	Perimeter of system, at water surface	Inspections	Integrity, proper function	Daily, and as needed to evaluate potential problem conditions	If the integrity or function of the system appears compromised, repairs or modifications will be implemented as necessary

Notes:
1. N/A – not applicable
2. NTU – nephelometric turbidity units

2.2.9 Wastewater Sampling

Water collected from isolation dewatering and decontamination will be treated by an on-site water treatment system. Performance sampling and required discharge sampling of the treatment system will be performed in accordance with the MI SRD. Treatment system performance will be performed for the first two weeks of wastewater treatment operations. Grab samples will be taken of the influent, between carbon units (Mid-GAC) and effluent locations. Samples will be submitted to the laboratory for analysis of PCBs, TSS and phosphorus. SRD sampling requirements are expected to require weekly sampling of the effluent for PCBs and TSS, with monthly samples for phosphorus.

2.2.10 Confirmation Sediment Sampling

Post removal sampling will include sediment confirmation sampling for each pre-established grid. One six-point composite sample will be collected from each of the grids for PCB analysis. Samples will be composted so as to represent PCB concentrations for a depth of 0-6 inches (in).

Node samples will be collected for the USEPA statistical analysis of project quality objectives. Discrete samples will be collected from eight of the confirmation grids. One or two of these node grid sample areas may be sampled in SA6 & SA7.

2.3 Sample Collection

Sampling will be performed throughout various stages of the project from pre-removal sediment sampling to post removal confirmation sampling.

2.3.1 Pre-Removal Sediment Sample Collection

Sampling of targeted grids to confirm pre-remediation PCB concentrations and removal depths (data gap sampling) will be performed in the grid areas presented in ***Figure 3*** to ***Figure* 9**. Depths for each area are presented in ***Table 3***. A sediment core will be manually driven to the desired sampling depth at each location. For each area, sampling of the most downstream grid will be accomplished first. Sampling will be performed by wading into the stream moving upstream to the desired locations. Once the coring device is pushed to the desired depth, creek water will be placed into the top of the tube and subsequently capped to create a vacuum to retain the sediment in the tubes, as necessary. The core will be slowly pulled from the sediment. Before the tube is fully removed from the water a cap will be placed on the bottom end to the tube to retain the sediments. For each sample point GPS coordinates will be recorded. In the event the coring device cannot be driven to the desired depth, a sediment core sampler will be used. EQ standard operating procedure (SOP) *SP-Soil-1 Sediment Sampling and Handling*

TABLE 3. PRE-REMOVAL SEDIMENT SAMPLING

Removal Area	Grid	Depth of Samples	No. Cores in Grid	No. of anticipated samples per core
Area 7				
	SA7-4	24 in	2	2
Area 6				
	SA6-1	24 in	1	2
	SA6-6	36 in	1	3
	SA6-10	24 in	1	2
	SA6-11	24 in	1	2
	SA6-14	36 in	2	6
Axtell Creek				
	AXC-1	36 in	1	3
	AXC-3	24 in	1	2
Area 5D				
	SA5-D1	36 in	2	6
	SA5-D2	36 in	1	3
	SA5-D3	36 in	1	3
	SA5-D4	36 in	1	3
	SA5-D7	36 in	1	3
	SA5-D12	48 in	1	4
	SA5-D14	48-60 in	1	4-5
Areas 5C				
	SA5-C2	36 in	1	3
	SA5-C3	36 in	1	3
	SA5-C4	48-60 in	1	4-5
	SA5-C5	48-60 in	1	4-5
Areas 5A				
	SA5-A5	48in	1	4
	SA5-A6	48in	1	4
	SA5-A7	48in	1	4
Area 3A				
	SA3-A1	36 in	1	3
	SA3-A2	36 in	1	3
	SA3-A7	36 in	1	3
Area 1A				
	SA1-A9	36 in	1	3

Notes:

in – inches
No. – number
No. of Samples indicates number of composite samples

Guidance presents additional detail regarding sediment sampling. This SOP is presented in Appendix A. Once the sediment core has been removed from the water the tube will be cut to drain the water above the sediment core. The core will be divided into 12 inch sections using a saw to cut through the coring device. Geotechnical information for each core will be recorded on a boring log, ***Figure 14***. A brief description of the lithological information for each subsection of the core will be documented. For each core collected per grid, 1 sample from each 12 inch depth (or partial 12 inch depth depending on material recovery) will be analyzed for PCBs. Each 12 inch section will be composited prior to filling the sample containers for PCB analysis. ***Table 3*** presents the desired maximum core depth and total cores collected for each grid. Field duplicates (FD) will be collected on a 1 per 10 sample frequency. Sufficient volume of sediments will be provided to ensure the laboratory has sufficient sample mass to perform a matrix spike and a matrix spike duplicate. Decontamination is not anticipated to be performed on the dedicated coring devices or to personnel waders.

2.3.2 Waste Characterization Sediment Sample Collection

In areas where sediments have been identified to contain PCBs levels at ≥ 50 mg/kg and <50 mg/kg composite samples will be taken of each waste stream. One sample will include portions of the removal grids with PCBs ≥ 50 ppm and one sample will include portions of the removal grids with PCBs <50 ppm. For *in situ* waste characterization sampling two to three locations within the removal area will be sampled to the specified removal depths for representative composite sampling. For *ex situ* waste characterization sampling, a representative composite sample(s) will be collected from each slope areas staged material. Composite samples will be submitted to the laboratory for Toxicity Characteristic Leaching Procedure (TCLP) volatiles (VOCs), TCLP semivolatiles (SVOCs), TCLP pesticides, TCLP herbicides, TCLP Resource Conservation and Recovery Act (RCRA) metals, PCBs, total cyanide, total sulfide, flashpoint and pH or as directed by the disposal facility.

2.3.3 Upjohn Park Soil Sample Collection

Upjohn Park surface soil samples will be taken to evaluate the potential for PCB contaminated sediment deposited in the Upjohn Park as a result of historical flooding of Portage Creek. Biased sampling locations will be identified through visible observations. These locations will include low lying areas, areas where visible sediment is observed or other areas of possible concern. In areas where vegetation is present the vegetation will be removed and the surface soil will be collected as grab samples of 0-2 inches below ground surface (bgs). Samples will be submitted to the laboratory for PCB analysis. EQ SOP *SP-Soil-4 Surface Soil Sampling* is presented in Appendix 1.

2.3.3 Pre- and Post-Construction Soil Sample Collection

Prior to establishing staging and processing support areas, pre-construction samples will be collected from the support area. Each support area will be divided into 2,500 sf sample areas for PCB analysis and 10,000 sf sample areas for total target compound list (TCL) VOCs, total TCL SVOCs, total target analyte list (TAL) metals. Each sample area will be sampled by taking a six point composite sample at 0-6 inches bgs in the 2,500 sf grid. A composite sample of four 2500 sf grids will be generated from the residual sample from the six-point composite. This composite sample, representing 10,000 sf will be submitted for the TCL and TAL parameters. ***Figure 10*** presents the proposed sample grids with the grab sample locations within each 2500 sf grid randomly selected. In those grids where total sf is <2,500 sf, a reduced number of sample points will be collected. In areas where the soil will be removed to install collection reservoirs, samples will be collected from the bottom of the targeted excavation. For example the collection reservoir for the dewatering staging pad will be placed 36 inches bgs. Samples will be collected at the bottom of the excavation prior to placement of materials necessary to construct the collection reservoir. Samples will be collected at approximately 0-6 inches in the bottom of excavations. Upon completion of work for each support area, such as the truck tire wash in SA7 post construction sampling will be performed. See ***Figures 11*** and ***12*** for support areas associated with removal activities in SA 6 and SA7. Two composite samples will be taken in SA7, one composite of the truck tire wash area and one composite of the decontamination and staging pad area. One composite sample will be taken from the tire/equipment wash area in SA6. Additional samples will be collected in access road areas. Support areas for the remaining removal areas will be identified in additional documentation (project plan addenda's) for the project in the subsequent years.

Post construction sampling will be performed in the same manner as pre-construction sampling. Sampling will be accomplished using a soil trier. Individual grab samples will be composited in the field by placing soils into a plastic baggie and mixing. One random location for each 10,000 sf or less area will be identified to collect grab samples for volatiles. Soil collected at this location will be placed directly into a 4 ounce (oz) glass jar with a Teflon lined lid. All samples will be analyzed for total target compound list (TCL) VOCs, total TCL SVOCs, total target analyte list (TAL) metals and PCBs. PCBs will be collected for each 2,500 sf area. To ensure work activities have not resulted in contaminating support areas results of the post construction samples will be compared to results of the pre-construction sampling. Procedures for surface soil sampling are presented in EQ SOPs *SP-Soil-4 Surface Soil Sampling*. This SOP is presented in Appendix 1. See the Quality Assurance Project Plan (QAPP) for target compound list and associated methods.

2.3.4 Borrow Source Material Sample Collection

Prior to using any borrow source material for backfill and restoration needs the materials will be sampled and analyzed to screen for potential contaminants. Composite samples of source material such as sand, and soils will be analyzed at a minimum rate of one sample per 5,000 CY at each location or supplier of each type of material. River run rock will be sampled *in situ* at its source location. Composite samples will consist of six subsamples collected from various regions of the borrow source material, to be selected in the field and biased towards any areas of staining, if present. Samples will be analyzed for total TCL VOCs, total TCL SVOCs, total TAL metals and PCBs.

2.3.5 Water Quality Sample Collection

2.3.5.1 Turbidity Measurements

During removal of PCB contaminated soil and sediment water quality monitoring will be performed upstream and downstream of the Removal Area to ensure control measures are effective in preventing the release of contaminated sediment. Water quality monitoring will include real time turbidity monitoring and surface water sampling. During removal each area will be isolated using sheet pile cofferdams. Surface water will be temporarily diverted by using by-pass pumping around the isolated excavation area and discharging downstream of the excavation area. To ensure the effectiveness of the cofferdam system the water quality will be monitored 200 ft upstream of the upstream cofferdam, 200 ft and 300 ft downstream of the discharge point. Turbidity monitoring will not be performed in SA7, as the removal activities are isolated to the flood plain. Real time turbidity will be measured with turbidity stations consisting of turbidity probes submerged mid depth at each of the specified locations. Data will be collected using data loggers stored in weather proof containers mounted on poles. The weather proof containers will also contain cellular modems to facilitate transfer of data to a work station at the Command Post. The data loggers will be programed to record turbidity measurement on 30 minute intervals. Additional turbidity measurements will be taken with a hand held turbidity meter. Information regarding ALs and frequency of measurements using the hand held meter are presented in Section 2.2.

2.3.5.2 Surface Water Sample Collection

Surface water samples will be collected weekly from the upstream and 300 ft downstream stations. These surface water grab samples will be submitted to the laboratory for PCBs, TSS, and phosphorus. Procedures for surface water sampling are presented in EQ SOPs *SP-Watr-4 Surface Water Sampling*. This SOP is presented in Appendix 1.

2.3.6 Personnel Sample Collection

Personnel sampling will be performed the first two weeks (or possibly during removal of highly concentrated material) of sediment removal and stabilization activities. One worker within the staging area will have his/her breathing zone monitored for PCBs. Sampling and analysis will be performed according to NIOSH Method 5503. Procedures for air monitoring and sampling are presented in EQ SOPs *SP-Air-9 Low Flow Air Sampling*. This SOP is presented in Appendix 1.

2.3.7 Area Sample Collection

Area sampling will be performed throughout the duration of the removal effort. Area sampling will include perimeter sampling at the staging/processing areas during stabilization activities. Samples will be taken for PCBs and total particulates. Sampling and analysis will be performed in accordance with NIOSH Methods 5503 and 0500 respectively. Procedures for air monitoring and sampling are presented in EQ SOPs *SP-Air-9 Low Flow Air Sampling*.

In addition to perimeter sampling periodic monitoring will be performed for total particulates using a DataRam particular monitor. These measurements will be taken within the stabilization area and removal areas as needed. Procedures for air monitoring are presented in EQ SOPs *SP-Air-8 Particulate Sampling, Real Time.* This SOP is presented in Appendix 1.

2.3.8 Waste Water Sample Collection

Recharge groundwater, decontamination water, and liquids removed from the sediment dewatering process will be treated at an on-site wastewater treatment plant and discharged back to Portage Creek, in accordance with the SRD. Once construction has been completed of the on-site wastewater treatment system and water treatment has been initiated sampling will begin. For the first two weeks of waste water treatment samples will be taken daily of the influent, between carbon units (Mid-GAC) and effluent monitoring points. Samples will be taken at designated sample ports as grab samples. Section 3 presents the sample handling requirements including sample volume and preservation requirements. These samples will be analyzed for PCBs, TSS and phosphorus. If the results from these first two weeks of sampling are satisfactory the sampling frequency will be reduced to once a week for PCBs and TSS, with phosphorus sampled once a month. Mid-GAC results will be reviewed to evaluate potential breakthrough of the carbon. Effluent results will be evaluated to ensure discharge concentrations are consistent with SRD requirements.

2.3.9 Confirmation Sediment Sample Collection

After removal of the PCB contaminated soils and sediments confirmation sampling will be performed prior to restoration. One six-point composite sample will be collected in approximately 2,250 sf grids to a depth of 6”. Results will be evaluated against the following performance or cleanup standards. The performance standard for designated stream sediments is ≤ 10 mg/kg of PCBs with a performance standard goal of 1 mg/kg. The performance standard for designated PCB contaminated floodplain and bank soils within the Portage Creek Area is 10 mg/kg with a performance standard goal of 5 mg/kg.

Node samples will be collected for the USEPA statistical analysis of project quality objectives. Six discrete samples will be collected from eight of the sample grids during confirmation sampling. The six sample locations will coincide with the locations used for the six point composite sampling.

3 SAMPLING QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

This section discusses the quality assurance/quality control (QA/QC) procedures to be used during implementation of the TCRA. These procedures will be implemented in conjunction with the QA/QC procedures contained the in the Portage Creek Removal QAPP.

3.1 QA/QC Samples

To assess the sampling and analysis process QC samples will be submitted for chemical analysis. Field duplicate samples will be split from pre-removal sediment grab samples by field personnel and submittal for laboratory analysis. The samples shall be submitted to Test America Laboratories facility in Dayton, Ohio (TAL-Dayton) along with the field samples, representing a rate of one field duplicate sample per 10 field samples collected.

For post removal confirmation sampling, FD will be collected during field composite sampling and submitted to TAL-Dayton for analysis. Approximately eight confirmation sample grids will be selected for node sampling. In these grids six discrete sediment samples will be taken as well as the one composite sediment sample. USEPA will perform statistical analysis to evaluate project objectives.

During Pre- and Post-Construction sampling FD will be randomly taken. FD will be submitted to the laboratory at a rate of 1/10 project samples.

When sampling surface waters for PCBs, TSS and phosphorus FD will be taken at a rate of 1/10 project samples. Periodic checks of the submerged turbidity meters will be performed by taking concurrent measurements with the hand held turbidity meter.

FD of the waste water treatment plan effluent will be taken throughout the duration of the project. FD will be taken at a rate of 1/10 project samples.

Table 4 presents the QA/QC samples to be taken and submitted for analysis. In addition, a sediment sample will be submitted at a rate of 1 sample per every 20 samples submitted for chemical analysis for use by the analytical laboratory as matrix spike (MS) and matrix spike duplicate (MSD) pairs.

TABLE 4. QA/QC SAMPLES

Sampling Task	No. Field Samples	No. Field Duplicate[3]	Field Blanks	MS/MSD
Targeted Grid Sampling	110-113	1/10 field samples	0	As needed by method
Waste Characterization	TBD	0	0	As needed by method
Extent of Contamination – Upjohn Park	TBD	1/10 field samples	0	As needed by method
Pre- & Post-Construction	TBD	1/10 field samples	1/10 field samples	As needed by method
Source Material	TBD	0	0	As needed by method
Water Quality Monitoring (SW Sampling)	TBD	1/10 field samples	0	As needed by method
Water Quality Monitoring (turbidity)	TBD	TBD	N/A	N/A
Personnel Workers	TBD	0	2 per sampling event	0
Area Monitoring	TBD	0		0
Waste Water Treatment	TBD	1/10 field samples	0	As needed by method
Confirmation Sediment Sampling	72	8	0	4

Notes:
1. TBD – to be determined, number of field samples can be dependent on duration of removal, water treatment, etc.
2. N/A – not applicable.
3. Frequency of field duplicates will be determined based on total number of samples taken for the project, versus number of samples taken for each sampling event.

3.2 Sampling Handling

3.2.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of certain locations to evaluate temporal changes. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events/conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected. Sample nomenclature will follow the guidelines presented in ***Table 5***.

3.2.2 Sample Containers and Preservation

Sample container preservation, packaging, shipping, and storage will be conducted in accordance with EQ SOP *SP-Othr-1 – Sample Packaging, Shipment, and Storage* (Appendix 1).

TABLE 5. SAMPLE NOMENCLATURE

Sampling Task	Sample ID	Matrix ID	Example	Explanation
Targeted Grid Sampling	PRSD-Removal Area-Grid ID-Core number (depth interval)	SD	PRSD-SA5-A6-1 (0-12”)	*Pre-removal sediment sampling from Removal Area 5A, grid A6, core number one at 0-12”*
Waste Characterization	WCSD-Removal Area-A or B	SD	WCSD-SA5A-A	*Waste characterization composite sample taken from Removal Area 5A, TSCA sediment*
Pre- & Post-Construction	PREC(or PSTC)-Support Area name-Removal Area sample number	SO	PSTC-Staging Pad-SA7-1	*Post-Construction Sample #1 taken from Staging Pad at Removal Area 7*
Upjohn Park Surface Soils	UJP-SS- Date-Sample number	SO	UJS-SS-093111-10	*10th Surface Soil Sample taken at Upjohn Park on 9/31/11*
Source Material	BS-Vendor-Material-Date-sample number	SO	BS-Joe’s Fill-sand-100511-1	*First sample taken of Borrow Source sample of sand material taken from vendor ‘Joe’s Fill’ on 10/5/11*
Water Quality Monitoring	Area-Location (US or DS200 or DS300)-SW-Date	SW	SA3A-DS300-SW-101511	*Surface water sample taken on 10/15/11at turbidity monitoring station located 300 ft downstream of Removal Area SA3A*
Personnel Workers	Task-Date	AR	Excavator-101011	*Personnel sample taken of worker on excavator on 10/10/11*
Area Monitoring	PRA(or SA)-Removal Area-Date-#	AR	PSA-SA7-092911-1	*First perimeter air sample taken in the support area for Removal Area 7 on 9/29/11*
Waste Water Treatment	WWINF(or MID, EFF)-Date	WW	WWINF-093011	*Wastewater sample taken at influent on 9/30/11*
Confirmation Sediment Sampling	CSD-Removal Area-Grid ID	SD	CSD-SA5-A7	*Confirmation sediment sample taken from Removal Area 5, Grid A7*
Node Sediment Sampling	NSD-Removal Area-Grid ID-#	SD	NSD-SA6-13-1	*Node confirmation sediment sample taken from Removal Area 6, Grid 13, sample number 1*

Notes:
1. ID – identification, SD – sediment, WC – waste characterization, SO – soil/solid, SW – surface water, AR – air, WW – waste water, BS – borrow source
2. PREC – pre-construction, PSTC – post-construction, UP – 200 ft upstream of removal area, DS200 – 200 ft downstream of removal area, DS300 – 300 ft downstream of removal area
3. INF – influent, MID – between GAC, EFF – effluent
4. All dates are recorded as MMDDYY.

Table 6 presents the required containers for each matrix and the parameter group. Additionally, the proper preservative and associated holding time for each parameter are included in the table.

A separate sealed container of water not intended for chemical analysis will be included in every cooler submitted to the analytical laboratory to be used as a temperature blank. Upon receipt at the laboratory, the temperature of the water in the temperature blank will be measured to verify that the sample has been properly chilled. For the samples requiring temperature preservation, if the sample is received at a temperature above 6°C, the EQ chemist will be contacted immediately to make necessary changes in shipping and packaging, and to determine if analysis will be conducted.

3.2.3 Sample Packaging and Shipping Requirements

As noted above sample packaging, shipping and storage will be conducted in accordance with EQ SOP SP-Othr-1. All samples will be transported and/or shipped under EQ's standard chain of custody procedures, custody seals will be utilized for every cooler of samples except when EQ personnel drop off samples. For the Portage Creek Removal effort samples will either be picked up by TestAmerica's Michigan service center in Brighton, MI a third party courier, transported to Dayton by EQ personnel or shipped via Federal Express. Test America will store samples for a period of 30 days beyond the issue of the final analytical laboratory report.

3.3 Documentation

EQ will maintain field records sufficient to recreate all sampling and measurement activities. The following information will be recorded in indelible ink for all field activities: 1) location, 2) date and time, 3) identity of person(s) performing the activity, 4) visitors, and 5) weather conditions. For field measurements, the following additional information will be recorded: 1) sample type and sampling method, 2) identity of each sample and depth(s), where applicable, from which it was collected, 3) sample volume, 4) sample description (e.g., color, odor, clarity, etc.), and 5) identification of the sampling device.

TABLE 6. SAMPLE PARAMETERS, METHODS, CONTAINERS, AND PRESERVATION

Parameter	Matrix	Analytical Method	Container	Preservative	Holding Time
Targeted Grid Sediment Sampling					
PCBs	sediment	SW8082	4 oz, Gl	4°	14 days for extraction, 40 days for analysis
Waste Characterization Sampling					
TCLP VOCs	sediment	SW1311/8260	4-oz Gl WM	4°C	14 days for TCLP extraction, 14 days for analysis
TCLP SVOCs	sediment	SW1311/8270	8-oz Gl WM[5]	4°C	14 days for TCLP extraction, 7 days for preparative extraction, 40 days for analysis
TCLP Pesticides	sediment	SW1311/8081	8-oz Gl WM[5]	4°C	
TCLP Herbicides	sediment	SW1311/8151	8-oz Gl WM[5]	4°C	
TCLP 8 RCRA Metals	sediment	SW1311/6010, 7470	8-oz Gl WM[5]	4°C	28 days for Hg, 6 months for all other metals for TCLP extraction, 28 days for Hg, 6 months for all other metals for analysis
PCBs	sediment	SW8082	4 oz, Gl[5]	4°	14 days for analysis
Total Cyanide	sediment	SW9012	4 oz, Gl[5]	4°	14 days for analysis
Total Sulfide	sediment	SW9034	4 oz, Gl[5]	4°	7 days for analysis
Flashpoint	sediment	1010/1020	4 oz, Gl[5]	4°	None
pH	sediment	9045	4 oz, Gl[5]	4°	Immediately
Upjohn Park Surface Soil Sampling					
PCBs	soil	SW8082	4 oz, Gl	4°	14 days for extraction, 40 days for analysis
Support Area: Pre-Construction & Post-Construction Surface Soil Sampling					
TCL VOCs	soil	SW8260	4-oz Gl WM	4°C	14 days for analysis
TCL SVOCs	soil	SW8270	8-oz Gl WM[7]	4°C	14 days for extraction, 40 days for analysis
TCL Pesticides	soil	SW8081	8-oz Gl WM[7]	4°C	
TCL Herbicides	soil	SW8151	8-oz Gl WM[7]	4°C	
TAL Metals	soil	SW6010 or 6020 & 7471	8-oz Gl WM[7]	4°C	28 days for Hg and 6 months for all other metals
PCBs	soil	SW8082	4-oz Gl WM[7]	4°C	14 days for analysis
Borrow Source Material Sampling					
TCL VOCs	solid	SW8260	4-oz Gl WM	4°C	14 days for analysis
TCL SVOCs	solid	SW8270	8-oz Gl WM[8]	4°C	14 days for extraction, 40 days for analysis
TCL Pesticides	solid	SW8081	8-oz Gl WM[7]	4°C	
TCL Herbicides	solid	SW8151	8-oz Gl WM[7]	4°C	
TAL Metals	solid	SW6010 or 6020 & 7471	8-oz Gl WM[8]	4°C	28 days for Hg and 6 months for all other metals

Table 6 - continued

Parameter	Matrix	Analytical Method	Container	Preservative	Holding Time
PCBs	solid	SW8082	4-oz Gl WM[8]	4°C	14 days for analysis
Water Quality Monitoring					
PCBs	SW	E608	1 L Gl Amber	4°C	7 days for extraction, 40 days for analysis
TSS	SW	SM2540D	500 ml, Pl	4°C	7 days for analysis
Phosphorus	SW	SM4500P	250 ml, Pl	H_2SO_4, 4°C	28 days for analysis
Personnel Workers					
PCBs	air	NIOSH 5503	filter, sorbent tube[9]	4°C	2 months
Area Monitoring					
PCBs	air	NIOSH 5503	filter, sorbet tube[9]	4°C	2 months
Total Particulates	air	NIOSH 0500	PVC[10]	None	None
Waste water Treatment Sampling					
PCBs	WW	E608	1 L Gl Amber	4°C	7 days for extraction, 40 days for analysis
TSS	WW	SM2540D	500 ml, Pl	4°C	7 days for analysis
Phosphorus	WW	SM4500P	250 ml, Pl	H_2SO_4, 4°C	28 days for analysis
Confirmation Sediment Sampling					
PCBs	sediment	SW8082	4 oz, Gl	4°	14 days for extraction, 40 days for analysis

Notes:
1. VOCs – volatiles, SVOCs – semivolatiles, Hg - mercury
2. TCLP – toxicity characteristic leaching procedure, RCRA – Resource Conservation and Recovery Act, RCRA 8 Metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver)
3. SW – SW846 EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
4. SM – Standard Methods for Analysis of Water and Wastewater
5. E – USEPA Clean Water Act Methods
6. oz – ounce, ml – milliliter, L – liter, Gl – glass, Pl – plastic, °C – degrees Celsius, WM – widemouth, SW – surface water, WW – waste water, PVC – poly vinyl chloride, H2SO4 – sulfuric acid
7. One 16 oz jar may be submitted for TCLP (SVOCs, Metals), PCBs, flashpoint and pH
8. One 8 oz jar may be submitted for SVOCs, Metals, and PCBs
9. Glass fiber filter + solid sorbent (13-mm glass fiber + florisil, 100 mg/50 mg)
10. 37-mm, 5-µm PVC filter

Records will be kept in the form of logs and standardized forms. These records may be in either hard or electronic versions. The standardized forms to be used are presented in Appendix 2.

3.4 Materials, Supplies, and Equipment

The equipment to be furnished by EQ or its subcontractors for collection of soil samples will be appropriate for taking samples from the materials expected to be found at the site. ***Table 7*** lists the materials, supplies, and equipment (including health and safety supplies) that will be used.

TABLE 7. MATERIALS, SUPPLIES, AND EQUIPMENT FOR SAMPLING

Sample containers	Lab coolers
Lab sample labels	Lab shipping stickers
COC Forms & Seals	Sharpie pens/Rite As Rain
Garbage bags	Tape – Duct, strapping and clear packing
Gloves - Disposable Nitrile	Safety Gear/PPE
Multi-Stage Sediment Sampler	Coring Device/Lexan Sleeve
Turbidity Probe/Station	Trier/Auger Coring Device
Sampling Scoops	Air Filters
DataRam	Personal Sampling Pump
Stainless Steel Bowls	Aluminum Trays
Spud Bar	Shovel
Personnel Waders	Drum
GPS Unit	Tape Measure, pin flags
Saw	5 Gallon Buckets
Handheld Sledge	Plastic Sheeting
Gallon Baggies	Log Book

4 DECONTAMINATION PROCEDURES

All non-reusable sampling equipment and supplies will be placed in a plastic bag after use and disposed of properly. For sampling equipment to be re-used, decontamination will be necessary to ensure that chemical analysis results are reflective of the actual concentrations present at the sample location. Disposable sampling equipment shall not be used to collect more than one sample. Proper decontamination minimizes the potential for cross contamination of samples and sampling sites and the transfer of contamination off site. All non-disposable sampling equipment used for collecting samples for chemical analysis will be decontaminated both prior to initiation of daily field sampling and between sample locations. To the extent possible, dedicated sampling equipment will be used at each sample location. All sampling equipment intended for use with this project will be disposable. The following in-field decontamination procedure will be used for non-dedicated sampling equipment:

- Liqui-Nox (or a non-phosphate equivalent) detergent/tap water wash
- Tap water rinse
- De-ionized water rinse
- Pesticide-grade isopropanol or methanol rinse (organics)
- Pesticide-grade hexane rinse (only if oily residue exists)
- Air-dry.

This process will be accomplished using 5-gallon buckets within the area of investigation. In lieu of air drying, a final de-ionized water rinse may be included (following the pesticide-grade isopropanol or methanol rinse) to avoid the possibility of trace organics adhering to the sampling equipment. If the equipment is not to be used soon, it must be wrapped in aluminum foil or placed in a plastic bag.

All IDW will be properly containerized, sampled, and characterized for disposal, as necessary. IDW waste water will include wash water collected from the washing and rinsing of vehicles, decontamination of sampling equipment, and water collected from isolation dewatering will be transferred and treated by the onsite waste water treatment plant. IDW consisting of personal protective equipment (PPE) and any other solid waste will be properly containerized for subsequent disposal.

FIGURES

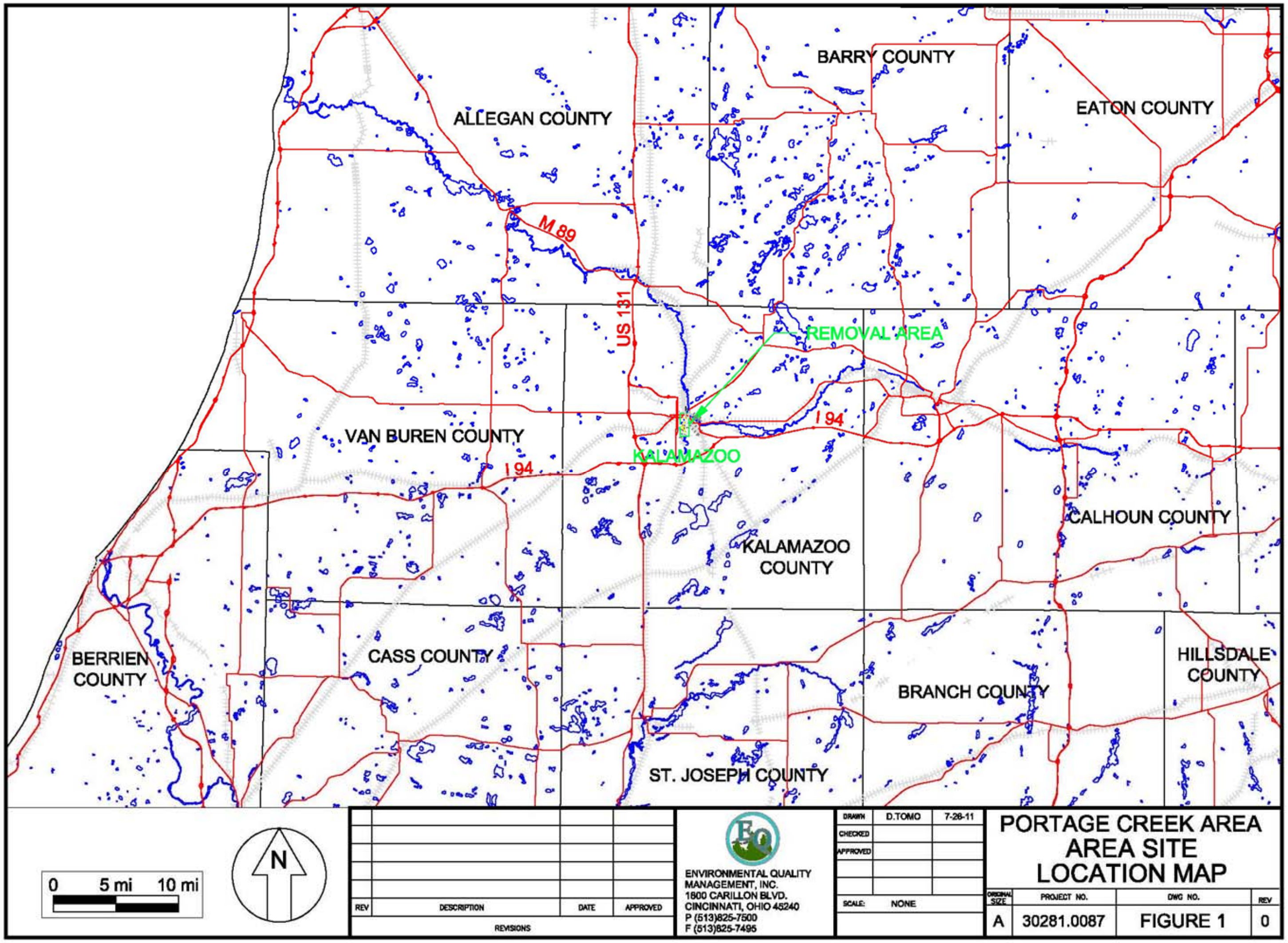

Figure 1. Site Location

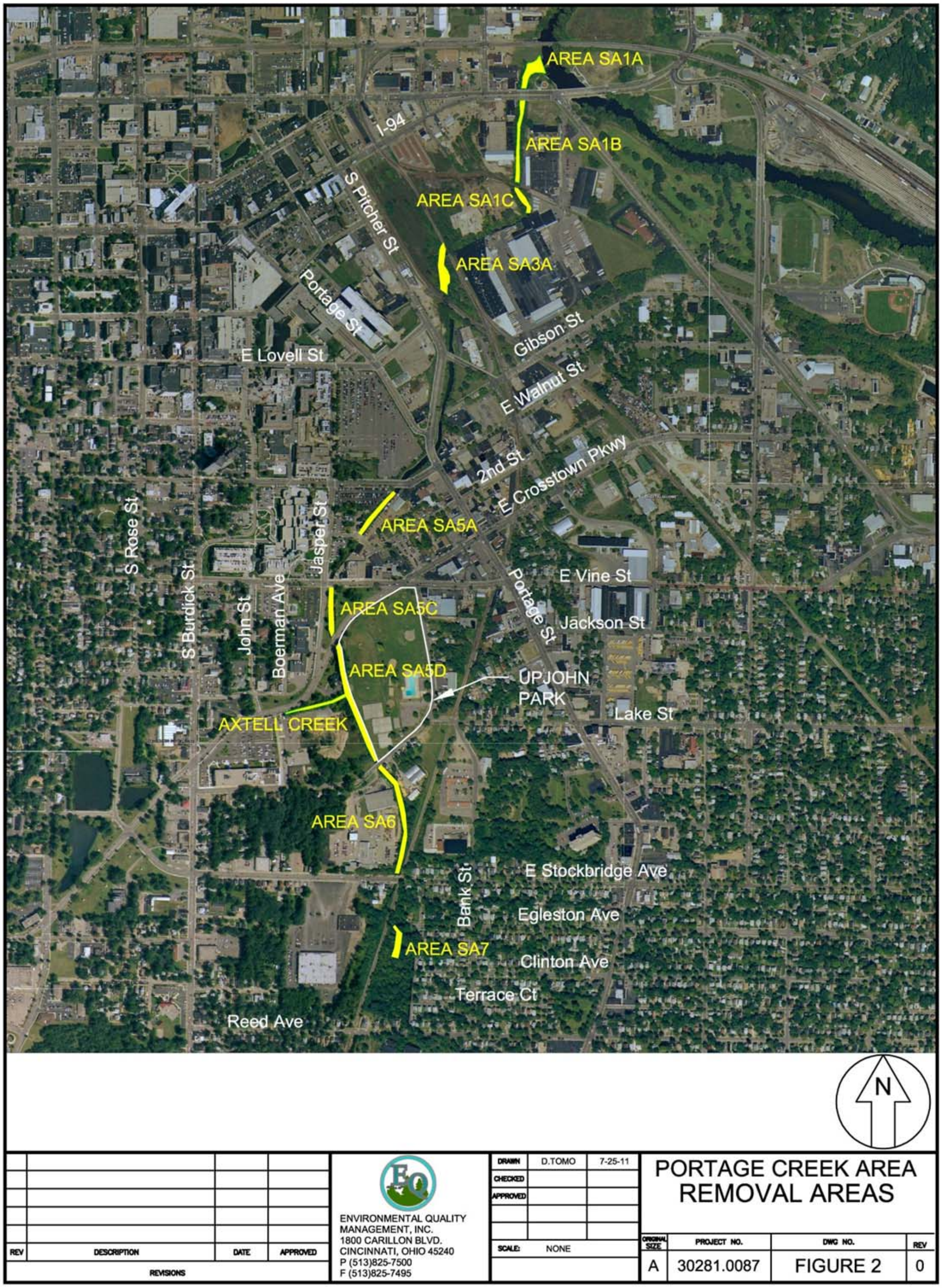

Figure 2. Removal Areas

Figure 3. Removal Area SA7

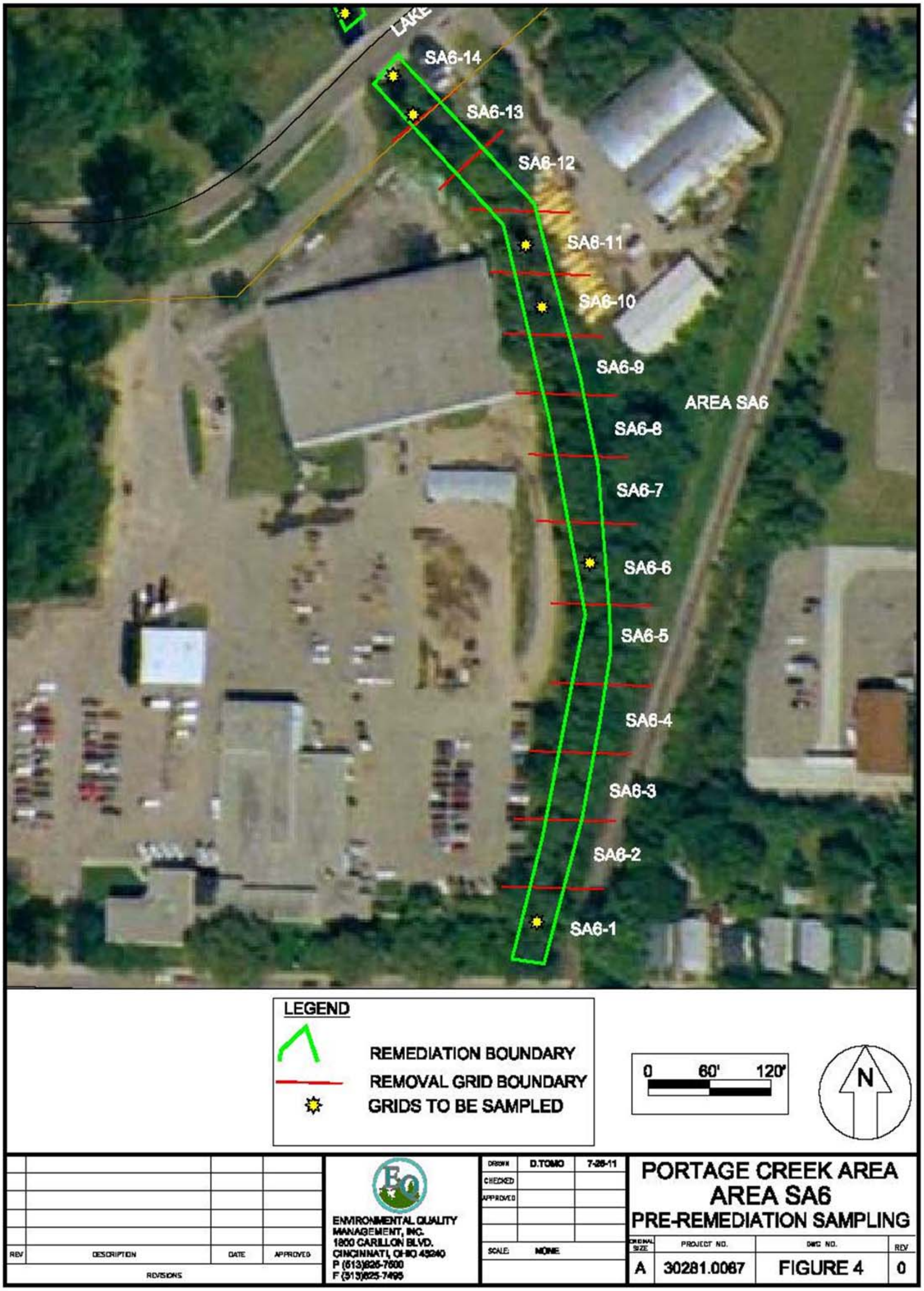

Figure 4. Removal Area SA6

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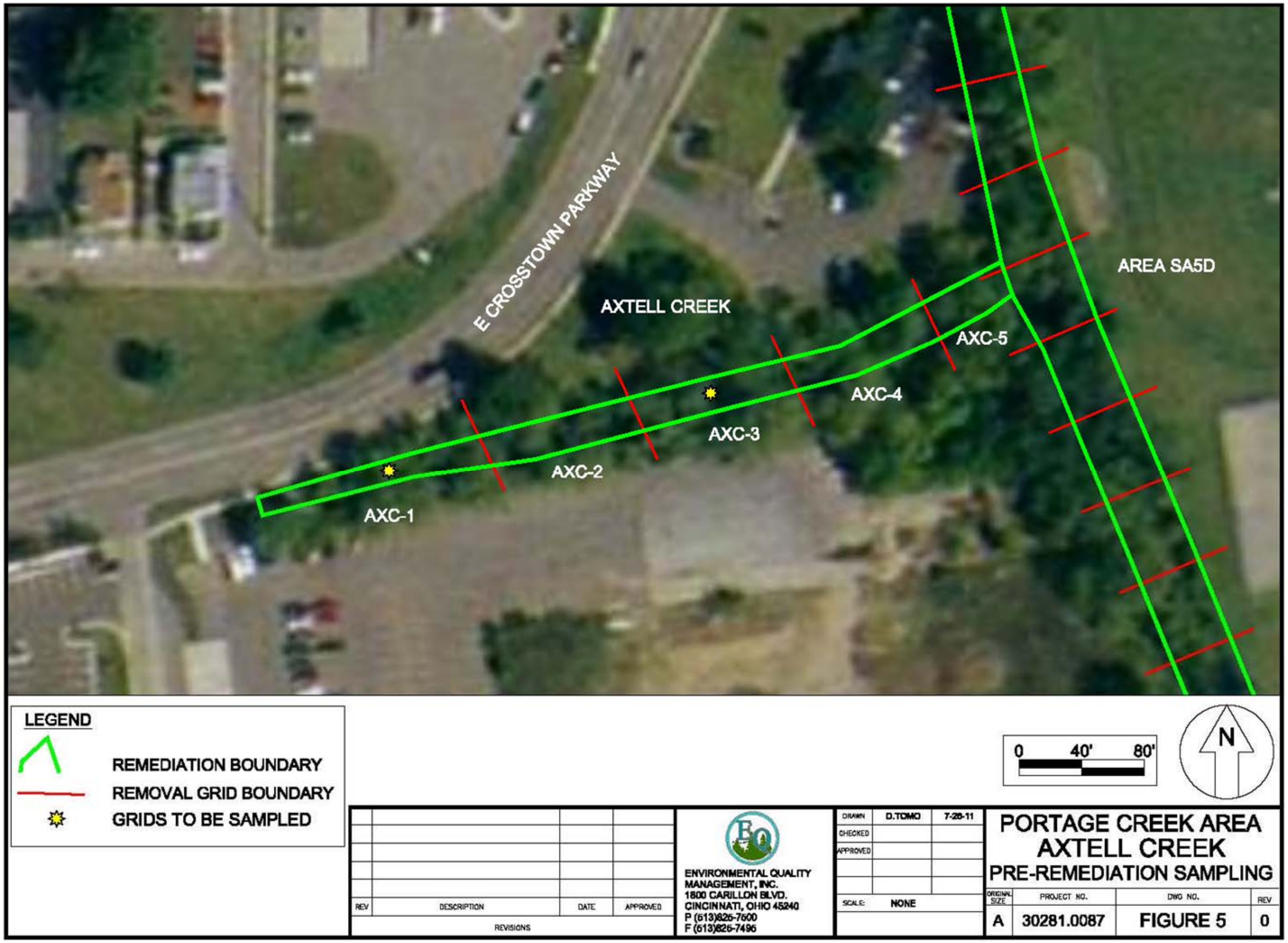

Figure 5. Removal Area Axtell Creek

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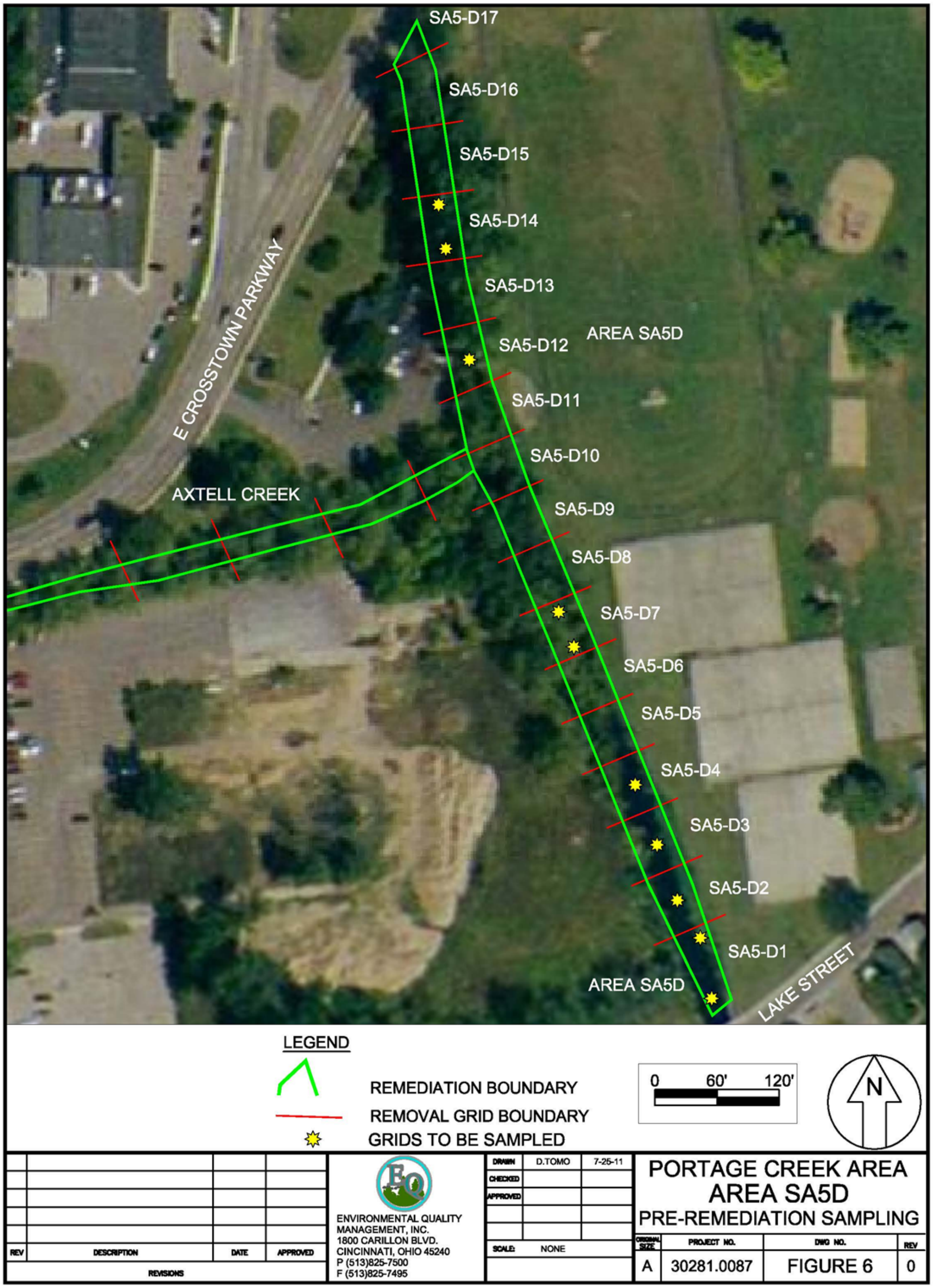

Figure 6. Removal Area SA5D

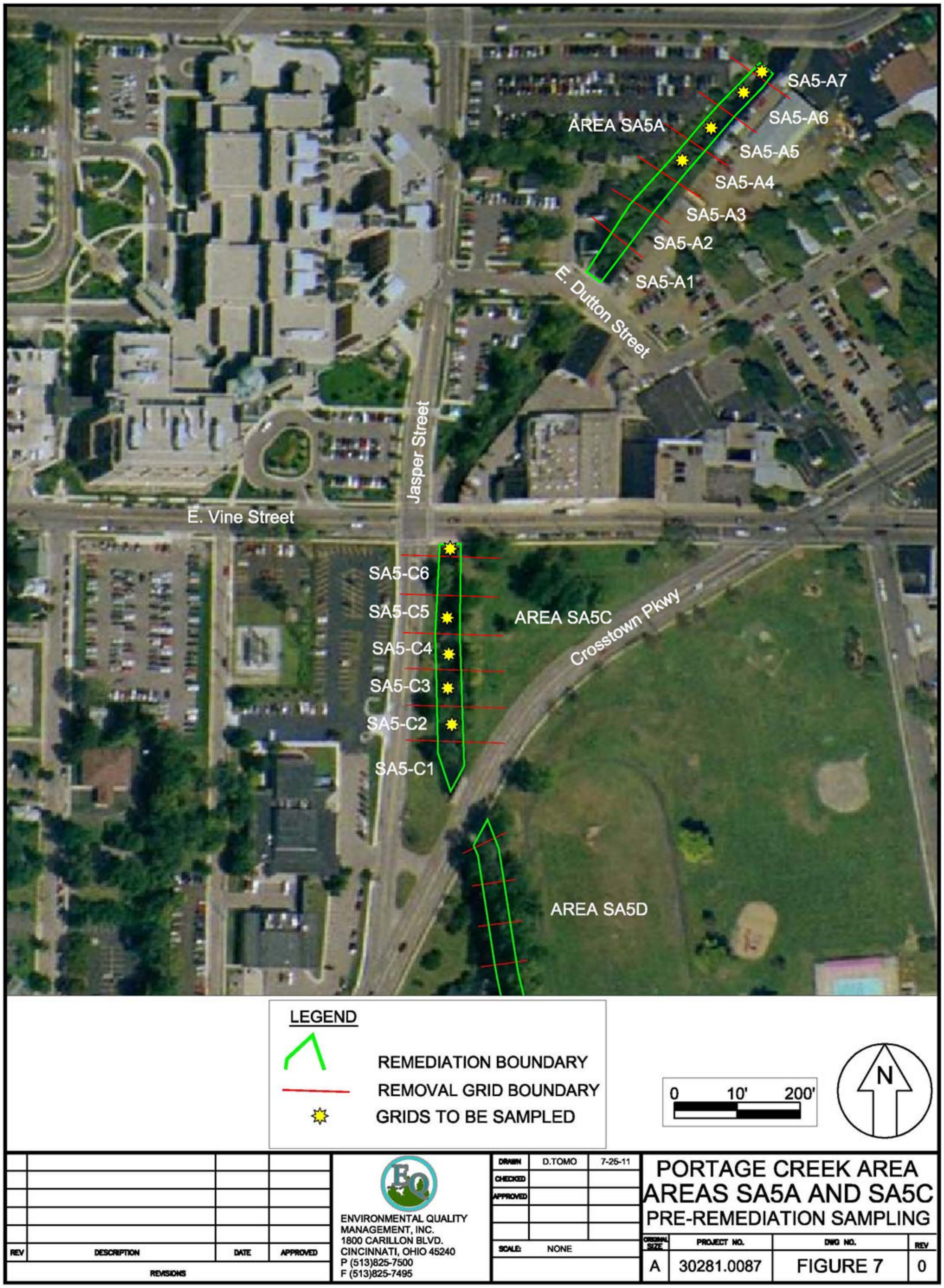

Figure 7. Removal Areas SA5A and SA5C

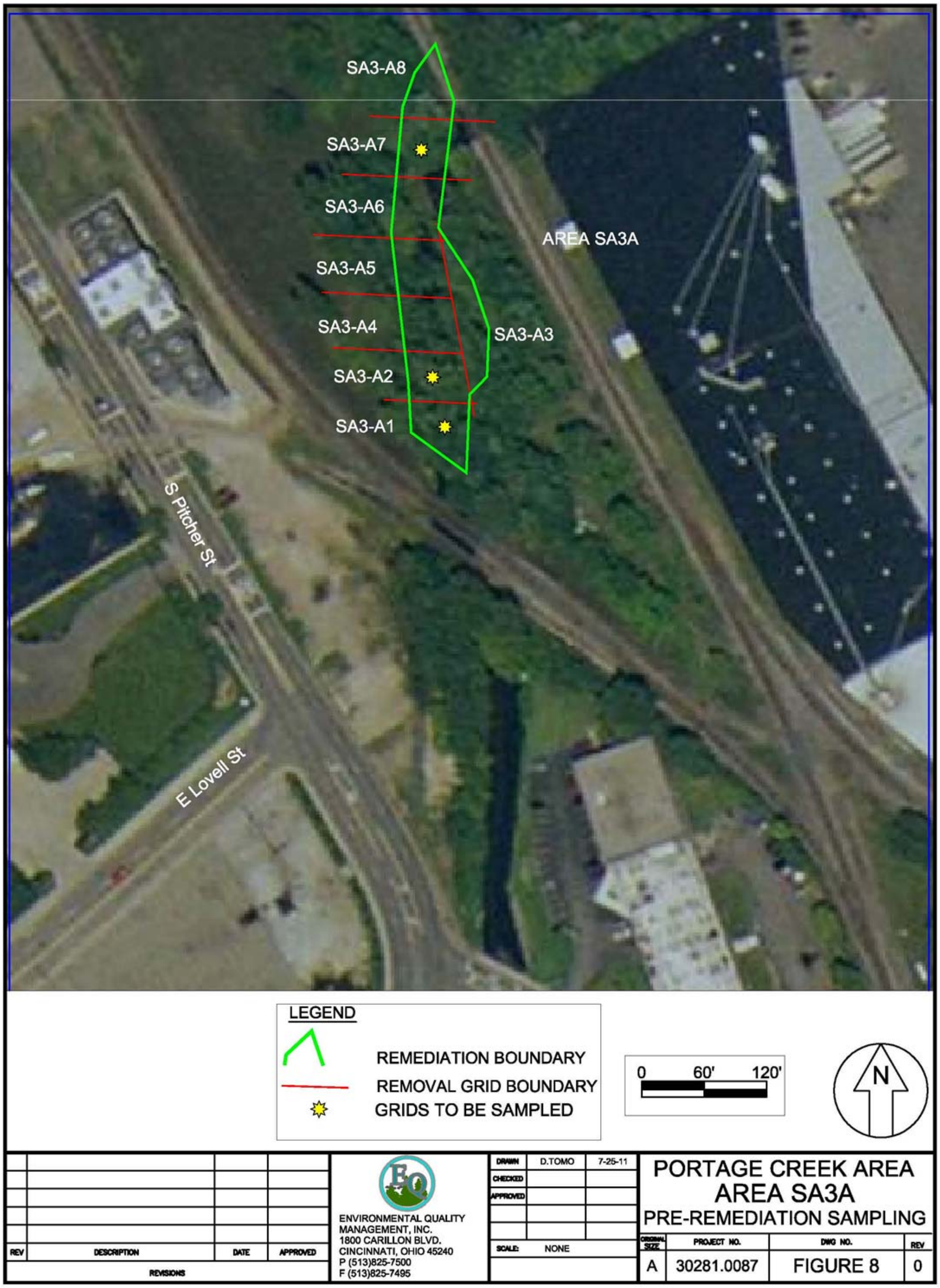

Figure 8. Removal Area SA3

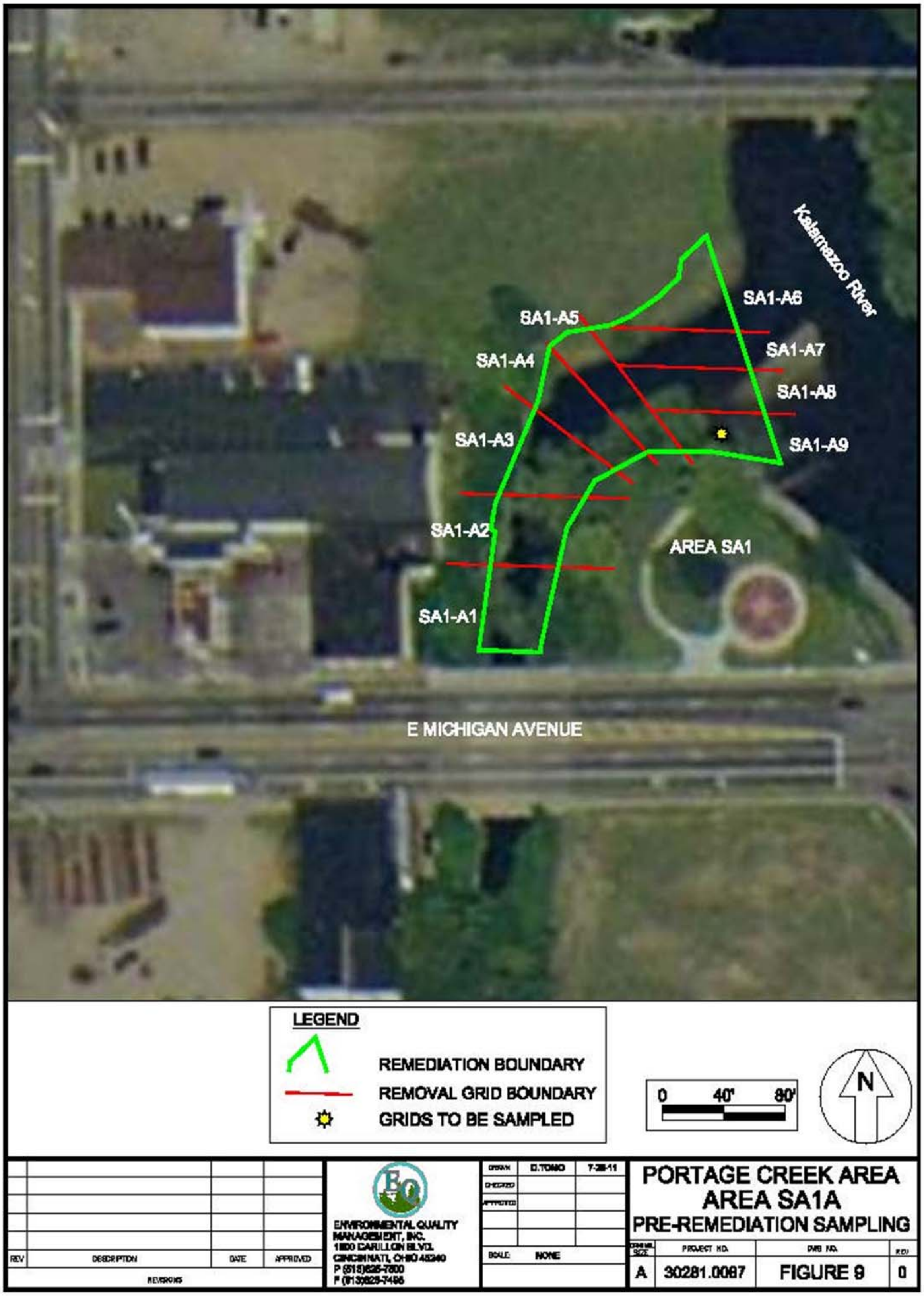

Figure 9. Removal Area SA1

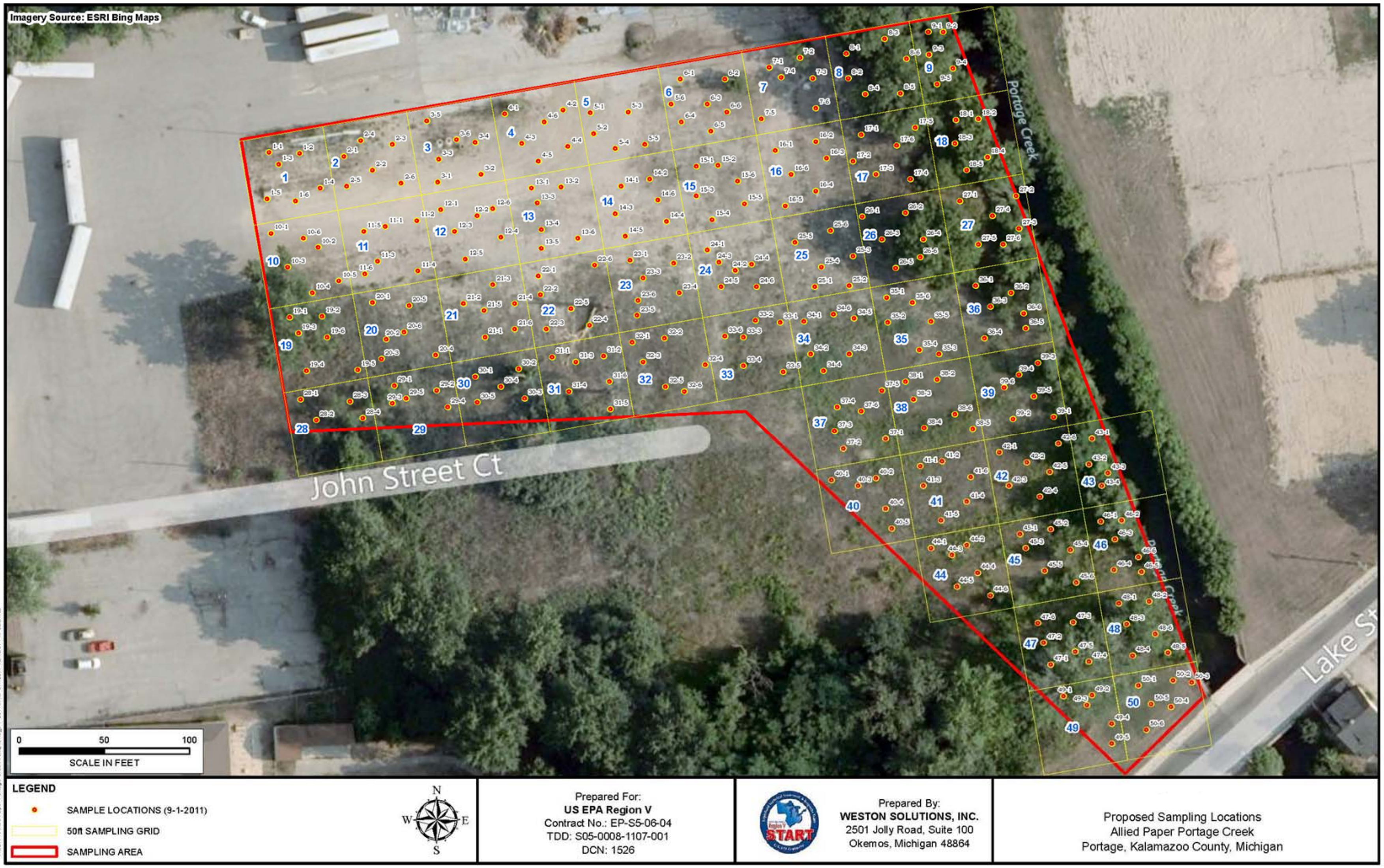

Figure 10. Sampling Locations at the Main Support Area

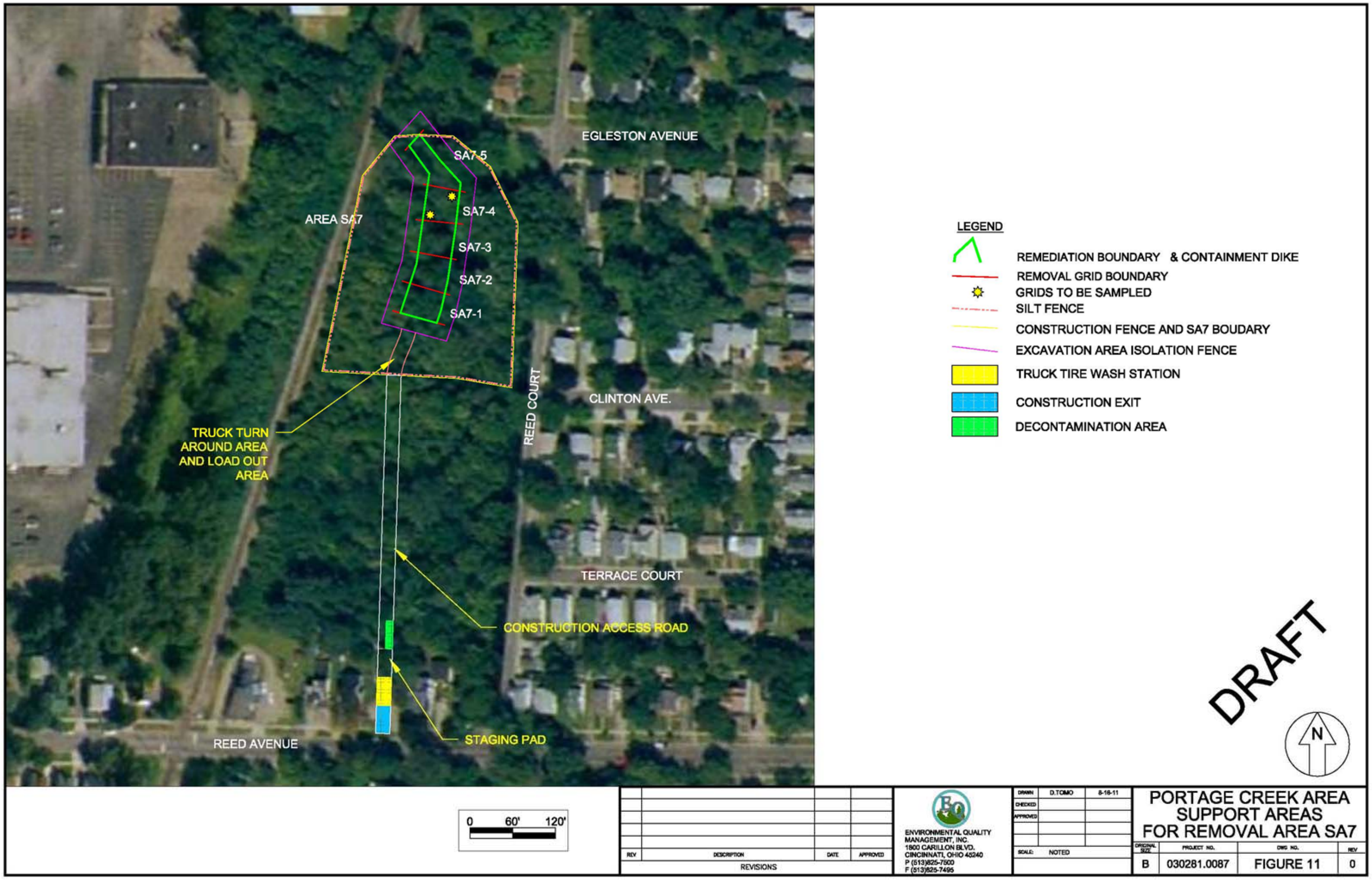

Figure 11. Support Areas for Removal Area SA7

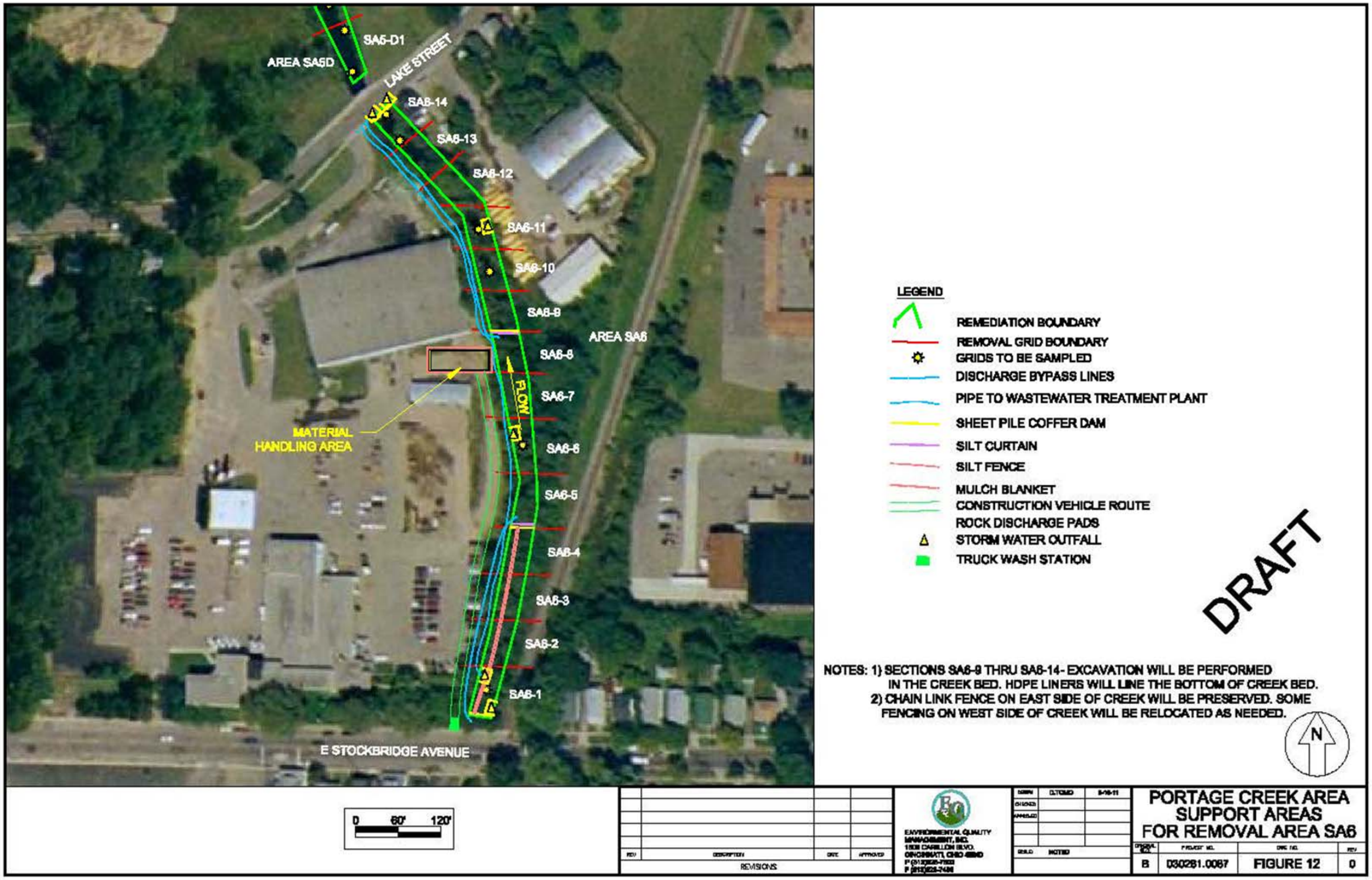

Figure 12. Support Areas for Removal Area SA6

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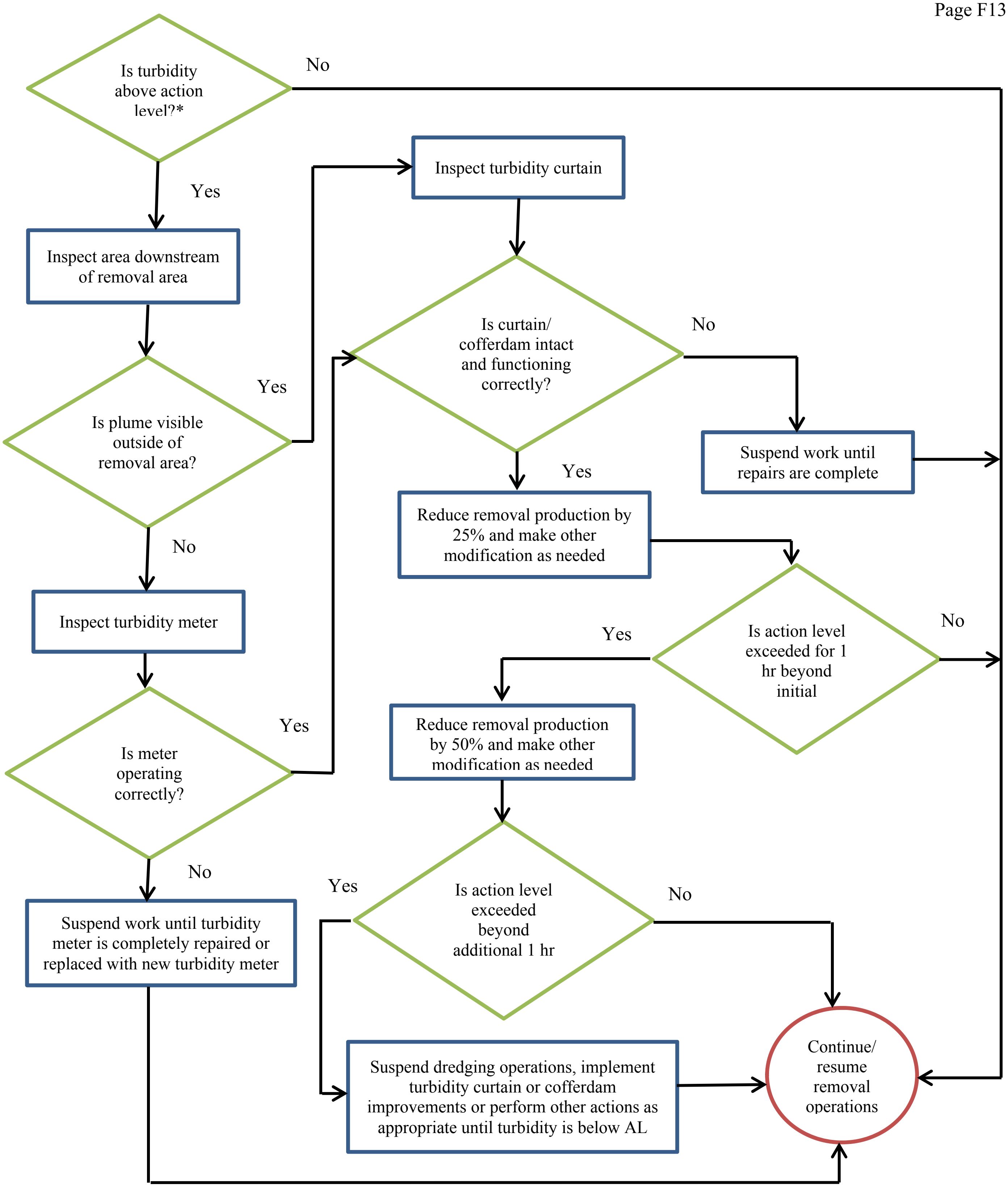

Figure 13. Mitigation Measures Flow Chart for Turbidity Monitoring

EQ Environmental Quality Management, Inc.	BORING LOG	Boring No:

Site: ____________
Location: ____________
EQ Project No.: ____________

Drilling Contractor: ____________
Driller: ____________
Date(s) Drilled: ____________
Drilling Method: ____________
Borehole Diameter (in.): ____________
Borehole Depth (ft.): ____________
Logged by: ____________
Air Monitoring Instrument: ____________
Surface Elevation: ____________
Depth to Water (ft.): ____________
Well Installed (Y/N): ____________

Site Sketch/Diagram:

Comments:

Background = ppm

Depth (ft.)	Sample No.	% Recovery	Lithologic Description	Water @	Headspace (ppm)
0					

Page 1 of 1

Figure 14. Boring Log

APPENDIX 1

EQ STANDARD OPERATING PROCEDURES

SP-Othr-1: Sample Packaging, Shipment, and Storage
SP-Air-8: Particulate Sampling, Real Time
SP-Air-9: Low-Volume Air Sampling
SP-Soil-1: Sediment Sampling and Handling
SP-Soil-4: Surface Soil Sampling
SP-Watr-7: Surface Water Sampling

Environmental Quality Management, Inc.

Standard Operating Procedure

Title:	**Sample Packaging, Shipment, and Storage**	**Document No.**	**SP-Othr-1**
Date of Issue:	**January 2007**	**Revision No.**	**4**
Point of Contact:	**(signature on file)**	**Approval:**	**(signature on file)**
	Colleen Lear, Geologist		**Jackie Doan, Corporate QA Director**

1.0 OVERVIEW

This document describes sample packaging, shipping, and storage procedures for any projects that will include sampling and analysis of liquid or solid media. This SOP is applicable to environmental assessment, remedial, or restoration projects requiring analysis. A review of the information contained within facilitates the planning of a sampling task. This is accomplished by providing reference documents, general information, definitions, responsibilities, standard procedure, and equipment.

2.0 RELATED DOCUMENTS

- *Test Methods for Evaluating Solid Waste*, EPA Office of Solid Waste and Emergency Response, SW846 Third Edition
- *Methods for Chemical Analysis of Water and Wastes*, EPA Environmental Monitoring and Support Laboratory, EPA-600/4-79-000
- Environmental Quality Management, Inc. SOPs: Liquid Sampling (SP-Watr-5); Surface Water Sampling (SP-Watr-7); Groundwater Sampling (SP-Watr-3); Laboratory Coordination (QA-4); Subsurface Soil Sampling (SP-Soil-3); Solid and Liquid Waste Sampling (SP-Othr-2)
- EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document

3.0 GENERAL INFORMATION

3.1 Objective

The objective of sampling is to collect a representative portion of material small enough in volume to be transported conveniently and handled in the laboratory while still accurately representing the material being sampled. This objective implies that the relative proportions or concentrations of all components will be the same in the samples as in the material being sampled, and that the sample will be handled in such a way that no significant changes in composition occur before the tests are made. This is accomplished by obtaining a sample that meets the requirements of the sampling program and handling it in such a way that it does not deteriorate or become contaminated before it reaches the laboratory.

3.2 Sample Custody

It is essential to ensure sample integrity from collection to data reporting. Proper handling, preparation, packaging, and shipment of samples are very important and can directly influence the results of the sampling event. Sample custody includes the ability to trace possession and handling of the sample from time of collection through analysis and final disposition. This is referred to as chain of custody.

3.3 Labels

Sample labels are used to prevent sample misidentification.

At a minimum, the following information should be included on the sample label:

- Project Code (project number, or site name)
- Station Number (unique location identification)
- Sample Identification Number
- Samplers
- Preservative
- Analysis
- Date/Time
- Type of Sample (discrete or composite, matrix).

An example of a sample label can be found in Attachment A.

3.4 Custody Seals

Sample or custody seals can be used to detect unauthorized tampering with samples up to the time of analysis.

Gummed paper seals or shrink seals can be used. They should include the following: project number, sample number or identification, collector's name, and date and time of sampling. For a sample seal or for a custody seal on a cooler, the date, signature, and company should be included. Attachment A includes an example of a custody seal.

3.5 Log Book

Field log books (i.e., Drum Logs, Tank Logs) are used to record all pertinent field and sampling information. At a minimum, the following should be included: date and time of sampling event, purpose of sampling, location of sampling task, name of field samplers, type of material being sampled, sampling equipment utilized, number of containers and sample volume taken, description of sampling point and sampling method, sample identification, field observations, and measurements.

3.6 Chain-of-Custody

A Chain-of-Custody is filled out to accompany each sample or group of samples. The record includes the following information: project name or number, collector's name and signature, project manager, sample number or identification, date and time sample is taken, sample matrix, volume of sample collected, number and type of sample container, and analytical requested including method and parameters. An example of a COC is included as Attachment B.

3.7 Container

The type of sample container is of utmost importance. Containers typically are made of plastic or glass, but one material may be preferred over the other. For example, silica, sodium, and fluoride may be leached from glass but not plastic, and trace levels of metals may adsorb onto the walls of glass containers. For samples containing organics, plastic containers should not be used except those made of fluorinated polymers such as polytetrafluoroethylene (PTFE). Consult with the Analytical Coordinator regarding the appropriate sample containers to use. Additional laboratory coordinators can designate the appropriate sample containers to be used based on the analysis to be performed.

3.8 Sample Volume

Sample volume must include additional sample volume needed for quality assurance (duplicates, matrix spike, etc.). Confirm with the Analytical Coordinator the required sample volume.

3.9 Preservation

Complete and absolute preservation of samples is a natural impossibility. Regardless of the sample nature, complete stability for every constituent can never be achieved. At best, preservation techniques only retard chemical and biological changes that inevitably continue after sample collection.

To minimize the potential for volatilization or biodegradation between sampling and analysis, keep samples at 4±2° C.

Chemical preservatives are only used when they do not interfere with the analysis being made. Preservation is intended to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce volatility of constituents. Confirm with the Analytical Coordinator the appropriate preservation.

4.0 DEFINITIONS

Chain of Custody - possession of a sample is considered under a person's custody if it is in the individual's physical possession, in the individual's sight, secured by that individual in a tamper-proof manner, or is secured in an area restricted to authorized personnel.

Samples – environmental samples are defined as those sample collected from environmental matrices such as soil, groundwater, or sediments.

5.0 RESPONSIBILITIES

5.1 Project Manager

- The Project Manager (PM) is responsible for communicating with the Analytical Coordinator in confirming the analytical needs of a particular task as outlined in a Project Specific Sampling and Analysis Plan (SAP).

5.2 Sample Team Leader

- Implements the SAP.

- Is responsible for all aspects of the sampling event including the Health and Safety of the sample team.

- Directs the Sample Technicians during the preparation and implementation of the sampling event.

- Is responsible for working with the Analytical Coordinator to clarify or confirm all the information regarding sample handling identified in the SAP.

- Maintains physical custody of samples until they are transferred off site or to an on-site laboratory.

- Coordinates with the Transportation and Disposal (T&D) Coordinator regarding the shipping requirements of the samples.

5.3 Sample Technician

- Reports directly to the Sample Team Leader.

- Prepares and dispatches sampling equipment and supplies to the site.

- Sets up sample control, storage, and equipment/personnel decontamination areas.

- Assists with sample collection, preparation/preservation, packaging, and labeling.

- Stores samples, completes chain-of-custody forms, maintains control of samples, and ships to lab or transfers custody to third party.

- Assists with field documentation (i.e., completes sample logs, maps and marks sampling locations, etc.).

6.0 PROCEDURE

- Prior to mobilization, assemble sample containers and preservatives. Preservatives are placed in sample containers, if analyte and sampling technique permit.

- Select a location on site for sample labeling and packaging. The location should minimize the potential for contamination of the sample(s) being collected.

- When possible, pre-printed information should be labeled prior to sample arrival at the site in order to save time. Label sample containers, listing parameter and sample identification. Date and time of sample collection will be added after sampling has been completed. All samples must be labeled with the sample label affixed to the container prior to shipping the samples.

- Complete the Chain-of-Custody (COC) to the extent possible, identifying the following information:

  - Identification of the laboratory, including name
  - address
  - points of contact
  - phone number
  - mode of sample transportation (i.e., overnight courier)
  - analysis
  - sample identification and labeled information

  An example COC is presented in Attachment B.

- Collect samples according to the SAP or appropriate SOP. Ensure that sufficient sample volume is collected. See Table 1 for minimum sample volumes. Note that samples designated for QA/QC (duplicate, matrix spike, etc.) will require additional sample volume. Samples collected for multiple analytes may permit reduced volume by combining analytes per sample bottle. An example of this is metals analyzed by SW6010. A one-liter aqueous sample collected can be analyzed for all metals except mercury. Confirm with the Analytical Coordinator the sample volume requirement. All sampling activities must be fully documented in a field logbook. Specific information regarding documentation requirements and sample designation will be found in the site-specific SAP.

- After the sample(s) have been taken, preservative is added immediately, if not added to the sample container prior to sample collection. For composite sampling, each aliquot should be preserved at the time of collection. When automated samplers are used, preserve after compositing and sample splitting is completed. Note that certain parameters are unable to be composited due to the characteristics of the sample or analyte of interest. Sample(s) are to be maintained at 4°C ± 2 during sampling and packaging.

- Water samples to be analyzed for dissolved analytes (i.e., dissolved metals) are to be filtered using a 0.45-micron membrane filter prior to preservation. The sample should be filtered immediately after sampling.

- Samples analyzed for volatile organic compounds should not be composited. Grab samples should be collected in a manner that is least disruptive to the matrix. The samples are to be placed in tightly sealed containers, with minimal headspace (waters with zero headspace), and stored at $\leq$4°C immediately.

- Samples should not be exposed to direct sunlight after collection. All samples should be stored, immediately after collection, at 4°C. Samples may be stored in insulated coolers. The cooler's drain plug, if present, must be securely taped shut.

- Samples with high concentrations of contaminants, such as oils, sludges, discarded products, are to be packaged as follows:

  – Sample container must be adequately labeled.

  – All bottles, except volatile vials, are taped shut with electrical tape (or other tape as appropriate).

  – Each sample bottle is placed in ziploc plastic bag.

  – Each bottle is placed upright in a separate paint can, the paint can is filled with vermiculite, and the lid is affixed to the can. The lid must be sealed with metals clips or with filament or evidence tape.

  – Arrows are placed on the can to indicate which end is up.

  – Outside of each can must contain the proper Department of Transportation (DOT) shipping name and identification number for the sample.

  – The cans are placed upright in a cooler that has had its drain plug taped inside and out, and has been lined with a plastic bag.

  – Vermiculite is placed on the bottom.

- Samples contained in clean ziploc plastic bags are placed upright in the shipping cooler, minimizing contact with other samples (packaging material may be necessary to ensure samples stay in place during shipping). If samples are not contained in ziploc bags, the samples should be stacked inside a large plastic bag (trashbag) and placed in the cooler.

- The completed COC should be placed in a clean ziploc plastic bag and secured with tape to the inside lid of the cooler.

- Ice shall be placed with the samples in the cooler. For best results, the ice should be contained in a large plastic bag (trashbag) to help prevent leakage.

- After the cooler lid is securely taped shut, the cooler is to be labeled as follows:

  - "This End Up" labels are to be placed on all four sides.
  - "Fragile" labels are to be placed on two sides.
  - Completed shipping labels are to be taped to lid of the cooler.
  - Signed Custody Seals are to be placed on the front right and left side of the cooler.

- Samples should be transported in accordance with all applicable and relevant safety and environmental laws and regulations at the federal, state, and local levels.

- The laboratory should be notified that a courier will be delivering the samples.

- Samples should be analyzed as soon as possible after collection. The times listed in Table 1 are the maximum times that samples may be held before analysis and still considered valid. Some samples may not be stable for the maximum time period given in the table.

7.0 EQUIPMENT, MATERIALS, AND SUPPLIES

7.1 Documents

- Sampling Plan
- Quality Assurance Project Plan
- Health and Safety Plan
- Field Log Book(s)

7.2 Sample Materials, Containers, and Forms

- Sample containers (as specified in project plans, plus 20%)

- Sample labels and seals
- Sample Log forms
- Ziploc plastic bags for sample containers and for protecting equipment from contamination
- Large plastic (trash) bags
- Shipping and labeling tapes

7.3 QA/QC Materials and Items

- Chain-of-Custody forms
- Lab request for analysis forms
- Shipping forms
- Trip Blanks
- Field and equipment rinseate blanks, field duplicates (project plans may call for these items to be prepared/collected during the sampling event)
- Ice chest or cooler for sample holding/shipment
- Ice

8.0 ATTACHMENTS

A Sample Label and Custody Seal
B Chain-of-Custody

TABLE 1
Sample Holding Times and Preservation Requirements

Wet Chemistry				
Parameter / Method(s)	Matrix[1]	Holding Time	Minimum Sample Size / Container[2]	Preservation
Acidity E305.1	aqueous	14 days	100 ml / P, G	Cool 4° C.
Alkalinity E310.1	aqueous	14 days	100 ml / P, G	Cool 4° C.
Biochemical Oxygen Demand (BOD) E 405.1	aqueous	48 hours	1000 ml / P, G	Cool 4° C.
Bromide E 320.1	aqueous	28 days	100 ml / P, G	None Required.
Chemical Oxygen Demand (COD) E 410.1, E410.2, E410.3, E410.4	aqueous	28 days	50 ml / P, G	H_2SO_4 to pH<2, Cool 4° C.
Chloride E 325.2, SW9250, SW9252, SW9257.	aqueous	28 days	50 ml / P, G	None Required.
Cyanide (CN) E335.1, E335.2, E335.3, SW9010, SW9012	aqueous solid	14 days 14 days	500 ml / P, G 100 g / P, G	NaOH to pH>12, 4° C, 0.6g ascorbic acid
Fluoride E340.1, E340.2, E340.3	aqueous	28 days	50 ml / P, G	None Required.
Hardness, Total E130.1, E130.2	aqueous	6 months	100 ml / P, G	HNO_3 to pH<2
Iodide E345.1	aqueous	24 hours	100 ml / P, G	Cool 4° C.
Methylene Blue Active Substances (Surfactants) E425.1	aqueous	48 hours	500 ml / P, G	Cool 4° C.
Nitrogen, Ammonia (N-NH_3) E350.1, E350.2, E350.3	aqueous	28 days	500 ml / P, G	H_2SO_4 to pH<2, Cool 4° C.
Nitrogen, TKN E 351.1, E351.2, E351.3, E351.4	aqueous	28 days	500 ml / P, G	H_2SO_4 to pH<2, Cool 4° C.
Nitrate (NO_3) E352.1, SW9200	aqueous	48 hours	100 ml / P, G	Cool 4° C.
Nitrate-Nitrite (NO_3 - NO_2) E353.1, E353.2, E353.3	aqueous	28 days	100 ml / P, G	H_2SO_4 to pH<2, Cool 4° C.
Nitrite (NO_2) E354.1	aqueous	48 hours	100 ml / P, G	Cool 4° C.

TABLE 1
Sample Holding Times and Preservation Requirements

Parameters by Chromatography				
Parameter	Matrix[1]	Holding Time	Minimum Sample Size / Container[2]	Preservation
Halogenated Volatile Organics SW8010	aqueous solid	14 days 14 days	3-40 ml vials / G 3-40 ml vials / G	Thiosulfate, Cool 4° C. Cool 4° C.
Non-halogenated Volatile Organics SW8015	aqueous solid	14 days 14 days	3-40 ml vials / G 3-40 ml vials / G	Thiosulfate, HCL pH<2, 4° C. Cool 4° C.
Purgeable Aromatics SW8020	aqueous solid	14 days 14 days	3-40 ml vials / G 3-40 ml vials / G	Thiosulfate, HCL pH<2, 4° C. Cool 4° C.
Acrolein & Acrylonitrile SW8030	aqueous solid	14 days 14 days	3-40 ml vials / G 3-40 ml vials / G	Thiosulfate, HCL pH 5, 4° C. Cool 4° C.
Phenols SW8040	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Phthalate Esters SW8060	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Nitrosamines SW8070	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Organochlorine Pesticides & PCBs SW8080	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Polynuclear Aromatic Hydrocarbons (PAHs) SW8100, SW8310	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Haloethers E611	aqueous	7 days	1L / amber G	Thiosulfate, Cool 4° C.
Chlorinated Hydrocarbons SW8120	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Organophosphorus Pesticides SW8140	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Chlorinated Herbicides SW8150	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Carbamate Pesticides SW8318	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Dioxins SW8280	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.
Explosive Residues SW8330	aqueous solid	7 days 14 days	1L / amber G 100g / G	Thiosulfate, Cool 4° C. Cool 4° C.

TABLE 1
Sample Holding Times and Preservation Requirements

Radiological				
Parameter	Matrix[1]	Holding Time	Minimum Sample Size / Container[2]	Preservation
Alpha, Beta, and Radium SW9310, SW9315	aqueous	180 days	2L / P	HNO_3 to pH<2.

Metals				
Parameter	Matrix[1]	Holding Time	Minimum Sample Size / Container[2]	Preservation
Aluminum (Al) SW7020, SW6010,	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Antimony (Sb) SW7040, SW7041, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Arsenic (As) SW7060, SW7061, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Barium (Ba) SW7080, SW7081, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Beryllium (Be) SW7090, SW7091, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Boron (B) SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Cadmium (Cd) SW7130, SW7131, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Calcium (Ca) SW7140, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Chromium (total) (Cr) SW7190, SW7191, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Chromium(hexavalent) [Cr(VI)] SW7196, SW7197, SW7198	aqueous solid	24 hours 24 hours	500 ml /P, G 100 g /P, G	Cool 4° C. Cool 4° C.
Cobalt (Co) SW7200, SW7201, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Copper (Cu) SW7210, SW7211, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Iron (Fe) SW7380, SW7381, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.

TABLE 1
Sample Holding Times and Preservation Requirements

Metals, cont				
Parameter	Matrix[1]	Holding Time	Minimum Sample Size / Container[2]	Preservation
Lead (Pb) SW7420, SW7421, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Magnesium (Mg) SW7421, SW7450	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Manganese (Mn) SW7460, SW7461, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Mercury (Hg) SW7470	aqueous solid	28 days 28 days	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Molybdenum (Mo) SW7480, SW7481, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Nickel (Ni) SW7520, SW7521, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Potassium (K) SW7610, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Selenium (Se) SW7740, SW7741, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Silica E200.7	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Silver (Ag) SW7760, SW7761, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Sodium (Na) SW7770, SW6010	aqueous solid	24 hours 24 hours	500 ml /P, G 100 g /P, G	Cool 4° C. Cool 4° C.
Thallium (Tl) SW7840, SW7841, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Tin (Sn) SW7870	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Titanium (Ti) E283.1, E283.2	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Vanadium (V) SW7910, SW7911, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.
Zinc (Zn) SW7950, SW7951, SW6010	aqueous solid	6 months 6 months	500 ml /P, G 100 g /P, G	HNO_3 to pH<2, Cool 4° C. Cool 4° C.

TABLE 1
Sample Holding Times and Preservation Requirements

Toxicity Characteristic Leaching Pprocedure (TCLP) or Synthetic Precipitation Leaching Procedure (SPLP)Parameters [3]				
Parameter	Matrix[1]	Holding Time	Minimum Sample Size / Container[2]	Preservation
Volatiles SW8240, SW8260	solid	14 days	50 g / G	Cool 4° C.
Semi-volatiles SW8270	solid	14 days	150 g / G	Cool 4° C.
Mercury (Hg) SW7470/, SW7471	solid	28 days	150 g / G	Cool 4° C.
Metals, except Hg (see note 4 below)	solid	6 months	150 g / G	Cool 4° C.

1 Aqueous samples include drinking water, groundwater, and wastewater.
2 Polyethylene (P) or Glass (G).
3 All sample are to be extracted according to Method SW1311 for TCLP, and SW1312 for SPLP.
4 See Metals table above for specific methods.

ATTACHMENT A
Sample Label and Custody Seal

ATTACHMENT A
Sample Label and Custody Seal

Sampler/Affiliation: EQ ____________

Site: ______________________

Sample ID: ____________________

Date: __________ Time: __________

____

____

2505

CUSTODY SEAL

Person Collecting Sample ______________________ Sample No. __________
(signature)

Date Collected ______________________ Time Collected 2505

1800 Carillon Blvd
Cincinnati, OH 45240
(513) 825-7500

Environmental Quality Management, Inc.
Chain of Custody Record

COC Tracking: **EQ-10000**

Project No.	Project Name
Samplers/Affiliation: *(Print Name and Sign)*	Lab P.O. No:

Sample ID:	Date	Time	Description/Matrix:	Sample Volume / Comments	No. of Containers	TESTS											

Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Ship To:
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Airbill Number

Reporting/QA Requirements:	Turn Around Time (***EXACT DUE DATE***):	Report To:	Chain of Custody Seal Numbers

Distribution: White - Accompanies Shipment Pink - Project Files Yellow - Laboratory File

Environmental Quality Management, Inc.

Standard Operating Procedure

Title:	**Particulate Sampling, Real-Time**	**Document No.**	**SP-Air-8**
Date of Issue:	**August 2010**	**Revision No.**	**6**
Point of Contact:	**(signature on file)** **Aaron Roski, Environmental Chemist**	**Approval:**	**(signature on file)** **Jackie Doan, Corporate QA Director**

1.0 OVERVIEW

The purpose of this procedure is to describe the method for real-time air sampling of total particulates using a light-scattering aerosol monitor (i.e., MINIRAM™ aerosol monitor).

This SOP is applicable for: 1) occupational exposure measurements, and 2) stationary (indoor or outdoor) ambient air measurements.

This SOP provides information on the proper equipment and techniques for completing the subject procedure.

Review of the information contained within facilitates real-time monitoring of total particulates. This is accomplished by providing reference documents, general information, definitions, responsibilities, standard procedures, an equipment list, and supporting data.

Note: A Personal Data Ram (PDR) may be required per site work specifications (data logging real time measurements). The MINIRAM and PDR measure particulates via the same method; however, operation, calibration, and additional data logging procedures are different. Follow the PDR Operations Manual for these procedures.

2.0 RELATED DOCUMENTS

- Air Sampling Instruments for Evaluation of Atmospheric Contaminants, the American Conference of Governmental Industrial Hygienists, 7th Edition, Cincinnati, Ohio, 1989.
- Personal Data RAM Instruction Manual, Thermo Anderson Inc.

3.0 GENERAL INFORMATION

The Personal Data RAM Model PDR-1000AN is a portable, hand-held airborne particulate monitor. This light-scattering aerosol monitor operates by illuminating aerosol particles (both solid and liquid) passing through a defined volume and detecting the total light scattered by all the particles within its sensing volume of one cubic centimeter. The PDR's liquid crystal display indicates the aerosol concentration in the units of milligrams per cubic meter of air, which can be updated every 1 second to 40 hours.

The operating range of the PDR is 0.001 mg/m^3 to 400 mg/m^3.

The PDR-1000AN satisfies the requirements for intrinsically safe operation in methane-air mixtures. Mine Safety and Health Administration (MSHA) 2G-4126 approval has been granted to the PDR-1000AN monitor.

This SOP pertains only to the operation of the PDR-1000AN personal monitor.

The PDR cannot be used to discriminate between different types of aerosols or particulates. The instrument will respond to all types of aerosol present simultaneously in the detection volume. Therefore, measurement of a small amount of specific aerosol (i.e., lead fume) in the presence of a large amount of interfering dust (welding fumes) is not possible with this instrument. However, if lead fume were the major aerosol component, the PDR would be the appropriate instrument to use.

High humidity or use of the PDR near water sprays, heated water baths, or other sources of airborne water vapor may result in a positive interference; i.e., the measured aerosol concentration may reflect water aerosol in addition to the contaminant of interest. In these situations care should be exercised when interpreting the results. Alternatively, non-real time sampling methods incorporating filter media should be used.

The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for total particulate is 15 mg/m^3, as an 8 hour time-weighted average. The American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) Threshold Limit Value (TLV) for total particulate is 10 mg/m^3, as an 8 hour TWA. In both cases, the particulate represents nuisance dust; i.e., it contains < 1% asbestos and < 1% crystalline silica.

4.0 DEFINITIONS

mg/m^3 - milligrams of particulate per cubic meter of air.

PEL - permissible exposure limit

TLV - threshold limit value

8-hour TWA - time-weighted average concentration for a normal 8-hour workday.

5.0 RESPONSIBILITIES

The project manager should ensure that adequate resources are available to conduct subject monitoring, i.e., implementation of this SOP.

The monitoring should be conducted by a trained industrial hygienist or field technician. These individuals are responsible for the following:

- Reading and implementing project or site-specific health and safety plan and sampling plan(s).
- Ensuring that the PDR is available to accomplish the sampling objectives.
- Reading and understanding the manufacturer's operations manual.
- For area sampling, locating and marking sampling locations. For personal sampling, selecting individuals to monitor.
- Decontaminating the instrument (if necessary) in accordance with the procedures outlined in the site-specific health and safety plan.
- Conducting a performance check of the monitor prior to use.
- Calibrating the monitor in the field before and after sampling.
- Maintaining sampling records, sampling logs, data sheets, and maps.

6.0 PROCEDURE

6.1 Air Monitoring

- Calibration is not required prior to use; the PDR is factory-calibrated.
- Zero the PDR using the Z-Pouch kit in accordance with manufacturers instructions. The Z-Pouch kit consists of a one-way flow rubber bulb for manual air pumping, a filter cartridge, a zippered plastic bag, and connecting hardware. The procedure is as follows:

- Remove the rubber bulb filter assembly from the Z-Pouch. Place the Z-Pouch on a flat surface with the red flow fitting facing up. Flatten bag. Remove the small plastic cap from the flow fitting on the bag.

- Insert the ribbed elbow connector (attached to filter cartridge) into the red flow fitting of the plastic bag, until the connector is flush with the bottom of the red flow fitting.

- The PDR should be in its OFF condition (observe display). If the display is blanked, or if the PDR is in the MEAS mode, turn the key OFF.

- Open the Z-Pouch and place the PDR inside, approximately at its center.

- Zip close the Z-Pourch and begin to pump the hand bulb until the bag is inflated.

- Follow manufacturer's instructions for zeroing the instrument; push the buttons through the bag.

- Unzip the Z-Pouch and remove the PDR. The PDR is now ready for monitoring.

- Place the rubber bulb/filter assembly inside the Z-Pouch, and plug the small plastic cap into the flow fitting to close it. Zip the Z-Pouch closed while flattening it for storage to ensure cleanliness of the bag interior.

• To start measuring airborne total aerosol concentrations, follow manufacturer's instructions and begin monitoring. After about 30 seconds have elapsed, the first interval averaged concentration (in mg/m^3) will be displayed on the LCD readout. All subsequent readings are updated at predetermined intervals. The instrument will operate continuously for up to about 20 hours on a 9-V battery.

• Record real-time airborne aerosol concentrations by manually transcribing levels on a Real Time Monitoring Log (Attachment 1) sampling data sheet or by outputting data stored in RAM on a printer. Section 10 of the operations manual should be reviewed prior to use of a printer.

6.2 Quality Assurance/Quality Control

Follow QA/QC requirements specified in the associated project-specific quality assurance plan.

6.3 Health and Safety

Health and Safety requirements for performing real-time aerosol monitoring aerosol should be identified in a project or site-specific health and safety plan.

6.4 Equipment Decontamination

In the event that the monitor becomes contaminated during its use, the decontamination procedure outlined in the site-specific health and safety plan should be followed.

7.0 EQUIPMENT

Aside from the PDR monitor, the following accessories are necessary for implementation of all aspects of this SOP:

- Z-Pouch calibration kit
- battery charger
- printer

8.0 ATTACHMENTS

A Real Time Monitoring Log

ATTACHMENT A

REAL TIME MONITORING LOG

Site Name: ______________________________ Project No.: ______________________________

DATE/TIME	SAMPLING LOCATION	INSTRUMENT (Mfg./Model)	MEASURED AGENT	RESULTS ( )	SAMPLED BY	COMMENTS/ ACTIVITIES

Environmental Quality Management, Inc.

Standard Operating Procedure

Title:	**Low-Volume Air Sampling**	**Document No.**	**SP-Air-9**
Date of Issue:	**August 2010**	**Revision No.**	**6**
Point of Contact:	**(signature on file)** **Aaron Roski, Environmental Chemist**	**Approval:**	**(signature on file)** **Jackie Doan, Corporate QA Director**

1.0 OVERVIEW

The purpose of this Standard Operating Procedure (SOP) is to describe a general procedure for collecting integrated personal and/or area air samples, whereby air contaminants (i.e., aerosols, particulates, gases, vapors) are removed from the air and concentrated by collection on filtration media or absorbing or adsorbing media. This SOP is applicable for assessing worker exposure to specific air contaminants in a variety of occupational settings. Information is provided on the proper equipment and techniques for collecting samples for specific contaminants of interest. Reference documents, general information, definitions, responsibilities, standard procedures, an equipment list, and supporting data are provided.

2.0 RELATED DOCUMENTS

Since this SOP provides a general procedure for the collection of personal and area air samples, the user must review the following primary sources of sampling and analytical methods to determine the specific sampling train to use. These primary sources include the compendia of methods recommended by NIOSH, OSHA, and EPA:

- National Institute for Occupational Safety and Health: NIOSH Manual of Analytical Methods, 4th Edition, Cincinnati, Ohio. Available from CCOHS on CD-ROM, 1994.

- Occupational Safety and Health Administration: OSHA Analytical Methods Manual. OSHA Analytical Laboratories, Salt Lake City, Utah. Available from ACGIH, Cincinnati, Ohio (1985).

- Compendium of ERT Air Sampling Procedures, U.S. EPA, Office of Emergency and Remedial Response, Washington, D.C. Publication No. 9360.4-05, May 1992.

Secondary sources include:

- Air Sampling Instruments for Evaluation of Atmospheric Contaminants, ACGIH, Inc., 7th Edition, Cincinnati, Ohio, 1989.

- American Industrial Hygiene Journal (AIHA).

- Applied Occupational and Environmental Hygiene (ACGIH).

Other related documents include:

- EQ SOP Standard Procedure No. 19 - Employee Exposure Notification.

3.0 GENERAL INFORMATION

The collection of personal or general area samples for airborne contaminants requires proper advance planning to ensure a smooth, successful survey. The first step is to determine the contaminants of interest so that the proper sampling media and analytical method can be selected. The document references included in Section 2 should be reviewed to facilitate selection of a specific sampling and analytical method. The procedures contained within each applicable sampling and analytical method would be the primary source of information for collection of the personal or general area air samples. These methods contain contaminant-specific information relative to the method, sampling media, flow rate, minimum and maximum air volume, potential interferences, estimated limit of detection, sampling equipment, calibration and quality control, and applicable occupational exposure standards for the contaminant of interest.

4.0 DEFINITIONS

ACGIH - American Conference of Governmental Industrial Hygienists, Inc.

Bulk Sample - solid or liquid sample of neat material which can assist the laboratory in the analysis of air samples. Examples include cutting fluid for oil mist samples or coal dust for crystalline silica samples. Bulk samples should only be provided to the laboratory upon request.

Field Blank - unused collection media (filters, sorbent tubes, impinger solution, etc.) which are handled in the same manner as the test samples with the exception that air is not drawn through the media. Field blanks measure any contamination which may occur after sampling but before analysis, i.e., during handling, shipping, and storage of samples.

LOD - limit of detection, minimum mass of analyte (usually reported in micrograms or milligrams) detected by analytical method.

Media Blank - collection media (unopened filters, sorbent tubes, or unused impinger solution) which are sent to the laboratory and analyzed to determine whether the media contains measurable quantities of the analyte(s) of interest. In the event that measurable quantities are detected in the media blank, detectable mass quantities in the test samples must be adjusted accordingly.

NIOSH - National Institute for Occupational Safety and Health.

OSHA - Occupational Safety and Health Administration.

5.0 RESPONSIBILITIES

The project manager should ensure that adequate resources are available to conduct the subject monitoring. The subject monitoring should be conducted by a trained industrial hygienist or industrial hygiene technician. The person conducting the air sampling should be responsible for the following tasks:

- Reading and implementing the project or site-specific health and safety plan and sampling and analytical plan(s).
- Ensuring that the appropriate sampling equipment and ancillary supplies are available to accomplish the sampling activities.
- Reading and understanding the contaminant-specific sampling and analytical methods.
- Decontaminating the personal sampling pump and sampling media in accordance with procedures outlined in the site-specific health and safety plan.
- Conducting performance and maintenance checks prior to using the sampling equipment.
- Calibrating the personal sampling pumps.
- Completing Sampling Data Sheet(s), Air Sampling Record, and Analysis Request and Chain-of-Custody Record (see Attachments 1, 2, and 3, respectively) to document collection and handling/transportation of samples.

6.0 PROCEDURES

6.1 Calibration of Personal/Low Volume Sampling Pump

- Connect the sample media (filter/impinger) to the pump intake and connect the calibrator (primary standard) to the intake of the media. With the media in line, turn on the pump and the calibrator.

- Press the button on the calibrator to produce the flow. The pump flow rate will appear on the calibration LCD screen. Adjust the flow of the sample pump to the desired flowrate.

- When the desired flow is obtained, measure the timing of three readings to confirm that the flow rate is consistent. A consistent flowrate corresponds to a 1 to 3% difference between the three readings. In the event that the three readings are not within 1 to 3%, the pump will be calibrated until the flow rate is consistent, or another pump will be used ($\mu_{UW} - \mu_{DW} = 0$). Record the Start flow rate as the average of the three readings. Repeat calibration at the conclusion of the sampling period. The pump flow rate may differ before and after sampling has been performed. In order to determine the flow rate during the sampling period, the average of the two flow rates will be used.

6.2 Sampling Instructions for Solid Sorbent Tube Samplers (i.e., activated charcoal, silica gel, porous polymers)

- Break the ends of the solid sorbent tube immediately before sampling to provide an opening at least one-half of the internal diameter at each end.

- Connect the solid sorbent tube to a calibrated personal sampling pump with flexible tubing; place the smaller sorbent section (backup section) nearer to the pump. Do not allow the air being sampled to pass through any hose or tubing before it enters the solid sorbent tube, unless the tube is preceded by a filter. Position the solid sorbent tube vertically during sampling to avoid channeling and premature breakthrough.

- Prepare the field blanks at about the same time as sampling is begun. These field blanks should consist of unused solid sorbent tubes <u>from the same lot</u> used for sample collection. Handle and ship the field blanks exactly as the samples (e.g., break the ends and seal with plastic caps), but do not draw air through the field blanks. Two field blanks are required for each 10 samples with a maximum of 10 field blanks per sample set.

- Collect the sample at an accurately known airflow rate and for the air volume as specified in the sampling method for the substance. Typical flow rates are in the range 0.01 to 2.0 L/min. Check the pump during sampling to determine that the flow rate has not changed. If sampling problems preclude the accurate measurement of air volume, discard the sample. Take two to four replicate samples for quality control for each set of field samples.

- Record pertinent sampling data including location of sample, time of beginning and end of sampling, initial and final air temperatures, relative humidity, and atmospheric pressure or elevation above sea level (see Attachments 1 and 2).

- Seal the ends of the tube immediately after sampling with plastic caps. Clearly label each sample and blank with permanent marker.

- To minimize breakage, pack the tubes tightly with adequate padding for shipment to the laboratory. In addition to the sample tubes and field blanks, ship at least six unopened tubes to be used as media blanks so that desorption efficiency studies can be performed on the same lot of sorbent used for sampling.

- Ship bulk samples in a separate package from the air samples to avoid sample contamination. Suitable containers for bulk samples are glass with a polytetrafluoroethylene (PTFE)-lined cap (e.g., 20-mL glass scintillation vials).

6.3 Sampling Instructions for Filter Samples [i.e., mixed cellulose ester, polycarbonate, polytetrafluoroethylene (PTFE), glass fiber, polyvinyl chloride (PVC), etc.]

- Assemble the filter in a two- or three-piece cassette filter holder. Support the filter by a stainless steel screen or cellulose backup pad. Close the cassette firmly to prevent sample leakage around the filter. Seal the filter holder with plastic tape or a shrinkable cellulose band. Connect the filter holder to the personal sampling pump by removing the filter holder plugs and attaching the filter holder to the personal sampling pump with a piece of flexible tubing.

- Clip the filter holder to the worker's lapel. Air being sampled should not pass through any hose or tubing before entering the filter holder.

- Prepare the field blanks at about the same time as sampling is begun. These field blanks should consist of unused filters and filter holders from the same lot used for sample collection. Handle and ship the field blanks exactly as the samples, but do not draw air through the field blanks. Two field blanks are required for each 10 samples with a maximum of 10 field blanks per sample set.

- Collect the sample at an accurately known airflow rate and for the air volume as specified in the sampling method for the substance. Typical flow rates are in the range 0.01 to 2.0 L/min. Check the pump during sampling to determine that the flow rate has not changed. If sampling problems preclude the accurate measurement of air volume, discard the sample. Take two to four replicate samples for quality control for each set of field samples.

- Record pertinent sampling data including location of sample, time of beginning and end of sampling, initial and final air temperatures, relative humidity, and atmospheric pressure or elevation above sea level (see Attachments 1 and 2).

- Disconnect the filter after sampling. Cap the inlet and outlet of the filter holder with plugs. Label the sample. Record pertinent sampling data including times of beginning and end of sampling, initial and final air temperatures, relative humidity, and atmospheric pressure or elevation above sea level (see Attachments 1 and 2 for Forms). Record the type of personal sampling pump used and location of sampler.

- Ship the samples to the laboratory as soon as possible in a suitable container designed to prevent damage in transit. Ship bulk material to the laboratory in a glass container with a PTFE-lined cap. Never store, transport, or mail the bulk sample in the same container as the air samples or field blanks. In addition to the air samples and field blanks, ship five unopened samplers from the same lot for use as media blanks.

6.4 Sampling Instructions for Filter and Cyclone Sampling (i.e., collection of respirable particulates using pre-weighed filter)

- Assemble the pre-weighed filter in the two-piece cassette filter holder. Support the filter with a stainless steel screen or cellulose backup pad. Close the cassette firmly to prevent sample leakage around the filter. Seal the filter holder with plastic tape or a shrinkable cellulose band.

- Remove the cyclone's grit cap and vortex finder before use and inspect the cyclone interior. If the inside is visibly scored, discard this cyclone since the dust separation characteristics of the cyclone might be altered. Clean the interior of the cyclone to prevent reentrainment of large particles.

- Assemble the two-piece filter holder, coupler, cyclone, and sampling head. The sampling head rigidly holds together the cyclone and filter holder. Check and adjust the alignment of the filter holder and cyclone in the sampling head to prevent leakage. Connect the outlet of the sampling head to the personal sampling pump by a 1-m piece of 6-mm ID flexible tubing.

- Clip the cyclone assembly to the worker's lapel and the personal sampling pump to the belt. Ensure that the cyclone hangs vertically. Explain to the worker why the cyclone must not be inverted.

- Prepare the field blanks at about the same time as sampling is begun. These field blanks should consist of unused filters and filter holders from the same lot used for sample collection. Handle and ship the field blanks exactly as was done for the samples, but do not draw air through the field blanks. Two field blanks are required for each 10 samples, with a maximum of 10 field blanks per sample set.

- Turn on the pump and begin sample collection. If necessary, reset the flow rate to the pre-calibrated 1.7-L/min setting, using the manufacturer's adjustment procedures. Since a filter can become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, observe the filter and personal sampling pump frequently to keep the flow rate within ± 5% of 1.7 L/min. The sampling should be terminated at the first evidence of a problem.

- Disconnect the filter after sampling. Cap the inlet and outlet of the filter holder with plugs. Label the sample with a permanent marker. Record pertinent sampling data including times of beginning and end of sampling, initial and final air temperatures, and atmospheric pressure or elevation above sea level (see Attachments 1 and 2). Record the type of personal sampling pump, filter, cyclone used, and the location of the sampler.

- Ship the samples and field blanks to the laboratory in a suitable container designed to prevent damage in transit. Ship bulk samples in a separate package.

- Take two to four replicate samples for every set of field samples to assure quality of the sampling procedures. The set of replicate samples should be exposed to the same dust environment, either in a laboratory dust chamber or in the field. The quality control samples must be taken with the same equipment, procedures, and personnel used in the routine field samples. The relative standard deviation, S_r, calculated from these replicates should be recorded on control charts and action taken when the precision is out of control.

6.5 Sampling Instructions for Impingers

- Ensure that the impinger is clean (properly decontaminated) and dry before use. If the impinger has just been decontaminated, rinse with the specified collection fluid twice before filling. Fill the impinger with the specified collection fluid (specific to the target analyte that is being sampled), and record the volume of fluid.

- Connect the impinger to a calibrated personal sampling pump with flexible tubing, place the impinger in the holder, and clip the holder and impinger to the worker's lapel or 3 meters above the floor surface for area samples. Ensure that the impinger is securely fastened so that fluid will not drain from the impinger. Do not allow the air being sampled to pass through any hose or tubing before it enters the impinger.

- Collect the sample at an accurately known airflow rate and for the air volume specified in the sampling method for the target analyte. Check the pump during sampling to ensure that the flow rate has not changed. If sampling problems preclude the accurate measurement of air volume, discard the sample. Evaluate the source of the problem and recollect the sample if necessary.

- Collect a reagent blank of the collection fluid to send to the laboratory for evaluation of bias that may be introduced by the collection fluid.

- Record pertinent sampling data including location of sample, time of beginning and end of sampling, initial and final air temperatures, relative humidity, and atmospheric pressure or elevation above sea level (see Attachments 1 and 2).

- Disconnect the impinger after sampling. Transfer the collection fluid to a vial, and seal and label the sample appropriately. Preserve the sample as necessary. Package and ship samples to the designated laboratory.

6.6 Quality Assurance/Quality Control

- Follow all QA/QC requirements specified in the associated sampling and analytical method and/or project-specific quality assurance plan.

- Collect field blank samples as specified in Sections 6.2, 6.3, and 6.4.

- Results of the quality control samples will be evaluated. Utilize this information to qualify the environmental sample results in accordance with data quality objectives.

- Complete the EQ Analysis Request and Chain-of-Custody Record (see Attachment 3).

6.7 Health and Safety

- Follow safe work practices outlined in the site-specific health and safety plan, EQ Corporate Plan, or OSHA guidelines.

- Specific hazards relating to implementation of this SOP include: sharp edges of cracked tubes; slip, trip and fall hazards at sampling location; and other physical and chemical hazards posed by work activities in the sampling area.

7.0 EQUIPMENT

- personal sampling pump
- sorbent tubes, filters
- flexible Tygon tubing
- 10-mm nylon cyclone (for respirable dust sampling)
- soap bubble meter or Gilibrator™ (or equivalent primary standard)
- tube holders
- filter cassettes

- tube breakers
- miniature screwdriver

8.0 ATTACHMENTS

1. Sampling Data Sheet
2. Air Sampling Record
3. Analysis Request and Chain-of-Custody Record

ATTACHMENT 1

ENVIRONMENTAL QUALITY
MANAGEMENT, INC.

SAMPLING DATA SHEET

Site: ______________________

PN ______________________

Date: ______ / ______ / ______

Page: __________ of ______

Sample description/location	Sample number	Pump ID no.	Flow Rate, lpm			Time		Duration, min.	Air volume, liters
			Start	Stop	Avg.	Start	Stop		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
Entries by:	Calculations by:					Checked by:			

ATTACHMENT 2

AIR SAMPLING RECORD

SITE NAME: ____________ PROJECT NO.: ____________ DATE: ____________

SAMPLED BY: ____________ SAMPLE I.D. NO.: ____________ PERSONAL/AREA
(Circle One)

EMPLOYEE: ____________ SS No.: ____________ SHIFT TIME: ____________
(If Applicable)

LOCATION: ____________ INDOORS/OUTDOORS
(Circle One)

WEATHER: ____________

ACTIVITIES/JOB TITLE: ____________ TEMP. (˚ F): ____________

HUMIDITY: ____________

WIND SPEED: ____________

CONTROLS/PPE: ____________ WIND DIRECTION: ____________

INSTRUMENT (I.D. No.): ____________ START TIME: ________ START FLOW: ________

SAMPLE METHOD: ____________ STOP TIME: ________ STOP FLOW: ________

AGENT: ____________ RUN TIME: ________ FLOW RATE: ________

SAMPLE MEDIA: ____________ AIR VOL.: ________

CALIB. SOURCE: ____________

COMMENTS: ____________

ANALYTICAL LAB: ____________ C-O-C No.: ____________

ANALYTICAL METHOD: ____________ ANALYTICAL DATE: ____________

DATE EMPLOYEE NOTIFIED: ____________ NOTIFIED BY: ____________

OTHER EMPLOYEES THAT RESULTS REPRESENT: ____________

ATTACHMENT 3

3325 Durham-Chapel Hill Blvd, Ste 250
Durham, NC 27707
(919)489-5299

Environmental Quality Management, Inc.
Chain of Custody Record

COC Tracking: EQ-10000

Project No.	Project Name	

Samplers/Affiliation: *(Print Name and Sign)*	Lab P.O. No:

Sample ID:	Date	Time	Description/Matrix:	Sample Volume / Comments	No. of Containers	TESTS											

Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Ship To:
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Airbill Number

Reporting/QA Requirements:	Turn Around Time (***EXACT DUE DATE***):	Report To:	Chain of Custody Seal Numbers

Distribution: White - Accompanies Shipment Pink - Project Files Yellow - Laboratory File

Environmental Quality Management, Inc.

Standard Operating Procedure

Title:	**Sediment Sampling and Handling Guidance**	**Document No.**	**SP-Soil-1**	
Date of Issue:	**August 2011**	**Revision No.**	**4**	**Page 1 of 29**
Point of Contact:	**(signature on file)** **Aaron Roski, Environmental Chemist**	**Approval:**	**(signature on file)** **Jackie Doan, Corporate QA Director**	

1.0 APPLICABILITY

This SOP provides recommended procedures for the collection and handling of bottom sediments for chemical, physical, and biological testing. The sampling methods discussed here are appropriate for Great Lakes tributaries and nearshore areas. Procedures for deep-water sediment sampling are not discussed.

2.0 PLANNING AND DESIGN

Prior to any field activities, sound planning is necessary to determine the type, number, location, and size of samples to be collected, and to ensure that the samples are not altered, biased, or contaminated in a way that would invalidate their use.

2.1 Objectives

The first and perhaps most important step in developing a sediment sampling plan is to define the objectives, which are a function of the types of information needed and the decisions to be made with that information. For example, a few composited grab samples may be suitable during the initial investigation to confirm the applicability of an exclusion or to help develop a contaminant of concern list, but might not be appropriate for a confirmation sampling plan.

Data quality objectives (DQOs) are qualitative and quantitative statements of the overall uncertainty a decision maker is willing to accept in the results or decisions derived from environmental data.

In summary, the objectives of a sediment sampling plan should address the type of information to be obtained, decisions that will be made with that information, and level of uncertainty that is acceptable for those decisions. These objectives should be elaborated in the written sampling plan.

2.2 Information Gathering

The types of data that should be compiled prior to initiating the sampling plan include:

- proposed dredging depths and locations
- water depths and level fluctuations
- obstructions (bridges, pipelines, ships, etc.)
- access sites for mobilizing equipment
- sources of contaminants (point and non-point)
- navigation use (commercial and recreational)
- hydraulic/other factors affecting sediment distribution
- historic sediment quality data
- survey benchmarks for referencing elevations at sampling locations
- landmarks for referencing sample locations
- emergency assistance (Coast Guard, hospitals, etc.).

Many site-specific factors will affect where and how sediment samples need to be collected. The complexity of the sampling plan will mirror the complexity of the anticipated sediment contaminant distribution. If the dredging area has few sources of sediment contamination or a very predictable contaminant distribution, the sampling layout may be relatively uncomplicated with focus on a single or a few reaches or zones. If there is a complex set of sediment contaminant concerns throughout a dredging area, however, the sampling layout may be complex as well.

2.3 Management Units

In an ideal situation, all types of information would be available on every grain of dredged material. The recommended method is to “focus” the sampling and analysis in a series of steps, consistent with the tiered approach. This method begins by characterizing the dredged material at a large number of locations by using “coarse” analyses. Successive steps employ more sophisticated analyses at fewer locations.

Every sediment sample will represent some larger area or volume in the evaluation. It is recommended that the area or volume represented by a sample be defined as part of the planning process, prior to field activities, where practical. This should enhance the objectivity of the evaluation and interpretation of data.

A **management unit** is a “manageable, dredgeable unit of sediment that can be differentiated by sampling and that can be separately dredged and disposed within a larger dredging area.” It is a spatially-defined volume of sediment located in a proposed dredging area for which the test results from a single sample (or composite) will be used to make a management decision about dredging or disposal. The management unit is therefore a decision unit.

A management unit must be constructible -- it must be practicable for normal dredging and disposal operations. A management unit could be as large as the entire dredging project area, or it could be a small portion of that area. A management unit should not be so small that it could not be dredged separately from other units. A management unit must also be constructible under a negative determination -- it must be possible to dredge other units and leave the one behind.

The homogeneity of the proposed dredge material, both physically and chemically, is the other factor to be used to delineate management units. Within a limited geographic area of a single waterway, it is reasonable to assume that sediments having similar physical and chemical characteristics would have similar potential for contaminant impacts. Although no predictable correlation between sediment chemistry and benthic or water column toxicity has been scientifically proven, the homogeneity of sediment physical and chemical properties is recommended as a reasonable basis for delineating management units and distributing sample locations.

2.4 Management Unit Delineation

Only a few generalizations about the appropriate size, number, and distribution of management units can be made. The delineation of management units is very site specific, and should consider all available information. Ultimately, the decision relies on best professional judgement.

A subset of the information gathered about the dredging site should be considered in laying out the management units:

- proposed dredging depths and locations
- water depths and seiche/tidal fluctuations
- sources of contaminants (point and non-point)
- hydraulic/other factors affecting sediment distribution
- historic sediment quality data.

The first step is to map out the proposed dredging area. This is often not one contiguous area, but a number of shoals with varying surface areas and thickness.

Information about the locations of known or suspected sources of contamination, factors affecting the movement of sediments and contaminants, and any historical sediment quality data can be used to estimate patterns of contaminant distribution in the proposed dredged material. The distribution of sediment contaminants in a riverrine setting is generally more predictable than in the harbors and marinas at the mouths of Great Lakes tributaries. In the former case, sediment contaminants tend to be more spatially linked to specific sources of pollution. In the latter, the contaminant distributions are complicated by the natural mixing of fluvial sediments from the river with littoral drift sediments moving along the near shore lake.

The physical and chemical characterization of sediments is closely interrelated, and the distribution of many contaminants often parallels the distribution of sediment physical characteristics. All other factors being equal, the most likely place to find elevated levels of contaminants is at locations having fine-grained sediments with higher levels of organic matter. A knowledge of the principles of sediment transport combined with information about the hydraulics of a waterway can help identify portions of a proposed dredging area with sediments most likely to have the highest levels of contamination.

In cases where there is little or no existing physical or chemical data on a proposed dredged material or disposal site sediment, a visual survey of sediments from the area, collected with a grab sampler, can yield highly valuable information. Field observations of sample odor and visual characteristics, together with laboratory analysis of sediment grain size distribution (sieve analysis) and organic content (total volatile solids or total organic carbon), are quick and reliable indicators of the distribution of sediment contamination within a given area.

If the sediments are believed to be relatively homogeneous, management units should be delineated in a fashion that divides the dredging area into units of approximately equal volumes. If there is less historical data in one portion of the dredging area than others, or if existing information suggests that there is a greater probability for contamination in one portion of the dredging area than others, it is appropriate to delineate smaller management units in these areas. If there are known or suspected patterns of physical or chemical characteristics of sediments in the dredging area, it is appropriate to delineate management units in line with these patterns.

In some areas, the physical and chemical characteristics of sediments may change with depth. This is common in navigation projects that have not been dredged in many years or in areas of a waterway which took many years for a deposit to accumulate. In these cases, the sources of contamination may have changed or been eliminated, and less- contaminated sediment deposits overlay older sediments with higher levels of contamination. In some projects involving “new work” dredging, a different pattern of vertical stratification can be found where surficial deposits of “recent” more contaminated sediments overlay uncontaminated deposits of sand or clay laid down in preindustrial times.

Sediment deposits which accumulate rapidly are less likely to have significant vertical stratification of contaminants. Areas that are routinely dredged every few years should, in most cases, not need to be vertically divided into more than one management unit. In cases where there are suspected vertical patterns of sediment physical or chemical properties, it may be practical to consider different disposal alternatives for different layers or strata. Such sediment layering may form the basis of management unit delineation. For example, if the area to be dredged had a deposit of unconsolidated silty sediments overlying an older deposit of compacted sand, management units could be divided vertically at the interface of the deposits.

2.5 Sampling Plan Documentation

A written plan for sediment sampling should be prepared and should include the following information:

- map of area to be dredged showing the delineation of management units, proposed sampling locations, and bathymetry
- rationale for management unit delineation
- map of disposal site showing proposed sampling locations
- proposed sampling methods and equipment
- proposed supporting equipment, vessels, and methods for positioning laterally and vertically
- proposed logistics for access/mobilization
- proposed sample compositing, handling, and transport
- personnel and contractors who will implement sampling and/or provide equipment
- QC/QA provisions
- health and safety provisions.

This sampling plan can be used for a number of project purposes, including:

- interagency coordination
- scope of work for contract or in-house
- part of the Quality Assurance Project Plan (QAPP)
- part of final report on sediment sampling and analysis.

3.0 SAMPLING EQUIPMENT

Three types of equipment generally are needed to collect sediment samples: a sampler; a mechanism for holding, driving, or lifting the sampler; and a floating platform to work from, as needed. Sediment sampling can be as simple as scooping a shovel into a shallow creek by hand or as complex as driving Teflon-lined Shelby tubes from a truck-mounted drill rig on a spud barge in 25 feet of water. This section will discuss the available equipment for sediment sampling and provide guidance on where it may be appropriate.

3.1 Sediment Samplers

There are two basic types of sediment samplers: grab samplers and core samplers. Both types of sampling devices can vary considerably in size and degree of difficulty in deployment. The selection of the type and size of sampling device used is, like other aspects of the sampling plan, project-specific. The features of sediment samplers commonly used in the Great Lakes are summarized in Table 1.

TABLE 1. FEATURES OF SEDIMENT SAMPLING EQUIPMENT

Sampler Type	Applicability	Penetration and Recovery	Sample Volume[1]	Supporting Equipment
Hand-held grab	Surface grabs in shallow depths, all sediments	Penetration controllable, recovery usually good	< 2 liters	None, except w/ divers
Drag line	Surface grabs in shallow depths, hard or compacted sediments	Shallow penetration	< 1 liter	Small boat
Small dredge	Surface grabs in all depths, all sediments	Penetration and recovery vary with sediment	1-2 liters	Small boat, winch
Clamshell bucket	Surface grabs in all depths, all sediments	Penetration of 1' or more, even in compacted sediment	> 100 liters	Floating plant, crane
Hand-held corer	Cores in shallow depths, soft sediments	Penetration controllable, recovery variable	1-2 liters	Pontoon boat or barge
Gravity corer	Cores in all depths, soft sediments	Penetration and recovery vary with sediment	1-2 liters	Small boat with winch
Box core	Short cores in all depths, all sediments	Shallow penetration, recovery usually good	variable	Boat with winch
Vibracore	Cores in depths less than 30', soft sediment	Penetration controllable, recovery usually good	variable	Floating plant and drill rig
Split spoon	Cores in depths less than 30', all sediments	Penetration controllable, recovery variable	1-2 liters	Floating plant and drill rig
Piston tube	Cores in depths less than 30', all sediments	Penetration controllable, recovery good	1-3 liters	Floating plant and drill rig

[1] Volume of sampler with good recovery

3.1.1 Sampler Selection

In comparing the different types of grab and core samplers, and selecting the one most appropriate for a particular application, the primary factors to consider are:

- reporting equipment requirements
- physical restrictions
- depth of sample (penetration)
- sample recovery
- sample bias
- sampler material
- sample volume.

Supporting equipment requirements: The type and size of supporting equipment needed for sampler operation may determine the feasibility of operation, and will greatly affect sampling costs. Supporting equipment are described further in Section 3.2.

Physical restrictions: Physical restrictions which might limit the operation of a sampler (and supporting equipment) include the water depths, currents/tidal/wave conditions, and sediment characteristics.

Sample penetration: The depth from which the sample is collected is determined by the depth of sampler penetration. For some samplers, this depth may be controlled. With other samplers, this depth is dependent on the type and size of sampler used, water depth, and consistency (soft/hard) of the bottom sediments.

Sample recovery: Recovery is an indication of how much sample is present in the sampler, and is usually estimated as a percentage, with a full sampler being 100% recovery. Poor recovery can result from the sampler failing to close properly or sample loss during lifting.

Sample bias: Sample bias is a significant concern, especially for samples that have poor recovery. As the sampler is pulled up, the sample may be lost to the water column through the sampler screen or if the sampler is not fully closed. Fine sediment particles are most susceptible to loss, and this preferential loss may bias the sample.

Sampler materials: Consideration must be given to the contaminating properties of the sampling devices themselves. Often there will be conflicting requirements for different test parameters. The general rule is that for metals analysis, samples should not contact metal samplers or containers and for trace organic analyses, samples should not contact any plastics. Samplers made of other material may also be suitable if the sample not in contact with the device can be selectively removed. All samples should be collected with the same sampler materials where possible. The use of different samplers for different analysis might complicate the interpretation of results.

Sample volume: The volume of sediment needed will vary with the test requirements. A summary of the sample volumes required for analyses is provided in Table 2. The approximate volume of sample provided by full (100% recovery) samplers is listed in Table 1.

TABLE 2. SAMPLE VOLUMES REQUIRED FOR ANALYSES

Analyses	Sample Volume	
	Sediment	Water[1]
Sieve analysis	0.5 liter	
Hydrometer analysis	0.5 liter	
Bulk chemistry[2]	0.5 liter	
Elutriate	1 liter	4 liters
Column settling test	40 liters	
Water column toxicity		
Whole sediment toxicity		
Bioaccumulation		

[1] Site water required for elutriate test. Other tests can use laboratory water.

[2] Volume shown for analysis of metals, nutrients, PCBs and PAHs. Larger volumes may be needed for analysis of other parameters or lower detection limits.

3.1.2 Grab Samplers

A grab sampler is any type of device that collects a disturbed sample at the sediment-water interface. A “disturbed” sample is one that has lost its vertical and lateral integrity and can’t be subdivided into meaningful layers or fractions (as can some core samples). Grab samples are collected at the sediment surface and represent the depth of sediment penetrated by the sampler.

Hand-held samplers: Shovel, trowels, and buckets can be used to collect sediment samples by hand in shallow streams. Sediment sampling in deeper waters by divers using hand-held samplers is becoming a fairly common practice. Hand-held grab samplers are inexpensive, require little or no supporting equipment, can control sample penetration to a limited extent, and generally have good recovery.

Drag-line samplers: Samplers have been developed which are operated by dragging along the bottom. These type of samplers include bottom dredges equipped with nets for collecting biological materials. A pipe dredge is a metal tube, about 6" in diameter and 18" long, which is used to collect surface samples from hard, rocky surfaces. This type of sampler may be more suitable for the disposal site than the dredged material.

Small dredge samplers: A number of small, light-weight dredge samplers are available from commercial sources. Some of these samplers come in several sizes. For example, the Ponar petite sampler (6" x 6") weighs about 25 pounds and can be operated by hand from a small boat. The Ponar (9" x 9"), shown in Figure 2, weighs about 50 pounds and needs a boat with a winch and cable for operation.

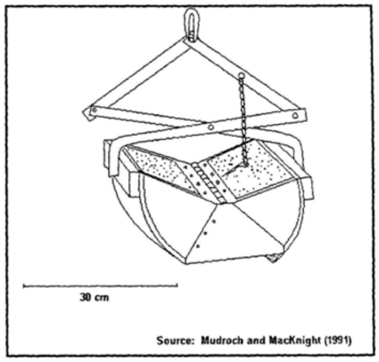

Figure 2. Ponar Dredge Sampler

Most small dredge samplers will only penetrate 1-3 inches in sandy sediments. The same sampler might penetrate 6-12 inches in fine-grained sediments that are soft and unconsolidated. Sediments that have a hard, consolidated surface often give poor recovery and may be subject to sample bias. Soft sediments will often yield 100% recovery with grab samplers.

Clamshell dredge bucket: Although not designed for sampling, commercial clamshell dredges (0.5-3 cubic yard bucket) can also be used for collecting sediment samples. Clamshell buckets are operated by a crane, and require a sizable floating plant (Figure 3). The bucket is typically lowered onto the deck of the floating plant, and sample(s) removed with shovels or trowels. A crane-operated clamshell bucket can penetrate several feet, even into compacted sand. Recovery is usually good. Sample bias can be avoided by compositing several subsamples from different areas within the bucket grab.

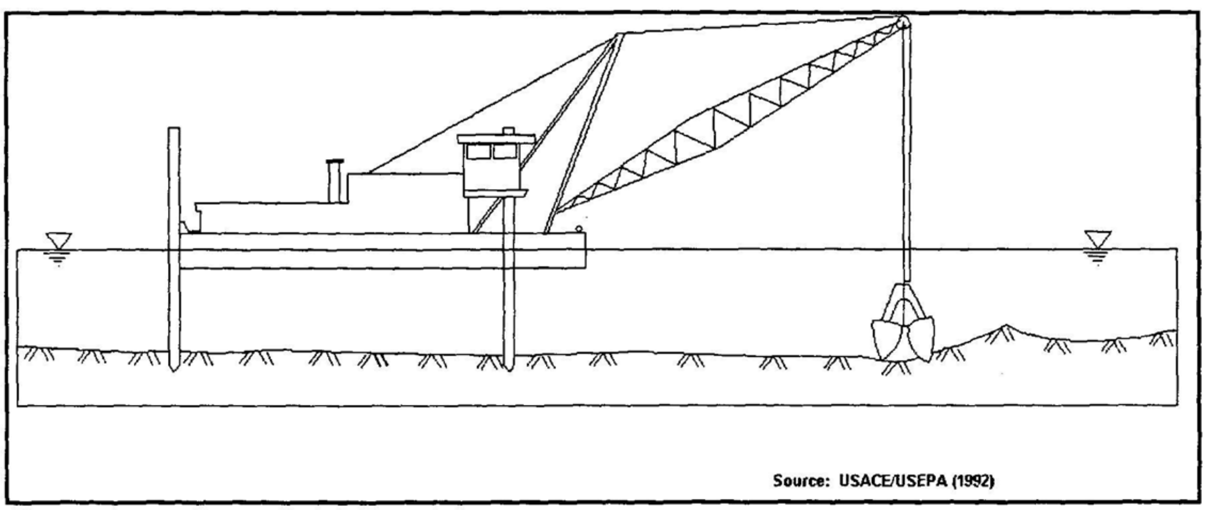

Figure 3. Clamshell Dredge on Spud Barge

The clamshell dredge bucket will provide far more sample than is necessary for sediment contaminant testing for 404(b)(1) evaluations. Multi-purpose sediment sampling may require large volumes. Several hundred gallons of sediment have been collected with clamshell dredges for testing and evaluation for confined disposal and treatability studies on contaminated sediments.

3.1.3 Core Samplers

A core sampler is a device that extracts a vertical cylinder of sediments of some length. The core sample may or may not fully retain its integrity. Some types of core samplers are designed to ensure the least loss of vertical integrity. For others, some loss of integrity is acceptable. Core sampling equipment that may be used include equipment designed for geotechnical exploration and well construction. In addition, several pieces of equipment are developed specifically for sampling bottom sediments. The features of the most commonly used core samplers are summarized in Table 1.

Hand-held samplers: Hand-held core samplers are available from commercial sources. Fabricated core sampling equipment can be designed from lengths of pipe. For some applications, this type of improvised sampler is quite acceptable. The pipe material used should be selected to avoid sample contamination (see discussion in Section 3.1.1). Tubes or sleeves of noncontaminating materials are available for commercial corers.

The hand-held core sampler is pushed into the sediments to the desired depth, topped with water to create a vacuum, and the bottom of the core sampler capped prior to withdrawing from the body of water. The sediments may be pushed out with a rod, or the pipe or tube cut to expose the sample for removal. Hand-held samplers can be used by wading in shallow streams or by divers. Hand-held samplers should not be operated from a boat because the operator must stand to drive and withdraw the sampler. Vessels with a flat deck, such as a small barge, pontoon boat, or floating plant, are needed to safely support the sampler.

The operation of a hand-held core sampler is limited by the depth to water, sediment characteristics, and sediment thickness. For total depths (water + sediment) greater than 10-15 feet, the length of the sampler becomes unwieldy for hand operations. Hand-held cores can be easily pushed through soft sediments, but are not recommended for consolidated materials. Recovery with hand-held core samplers is variable. A catcher is typically used at the front end of the core to hold the sediment in-place as the sampler is withdrawn. Samplers with an open end can also be “capped” by driving them through the soft sediments and a few inches into hard clay or sand.

The bias of a core sample is related to its recovery. A sample with poor recovery may have preferentially lost sediment from the leading (deeper) end. Hand-held cores may lose some vertical integrity, as sediments may be compressed in the core. A 3-foot drive may yield only 2 feet of sample, even with good recovery. Consequently, hand-held cores are acceptable for vertically composited samples, but vertical subdivision may not reflect the true elevation of sub-samples.

Gravity core samplers: A number of commercially available core samplers are deployed on a cable and penetrate the bottom sediments with only the force of gravity. A summary of available corers is provided by Mudroch and MacKnight (1991) and Sly (1969). Most corers have small diameters (1-2") with variable lengths, and come equipped with additional weights and a catcher. Some have vanes or stabilizing fins. A typical gravity corer is shown in Figure 4.

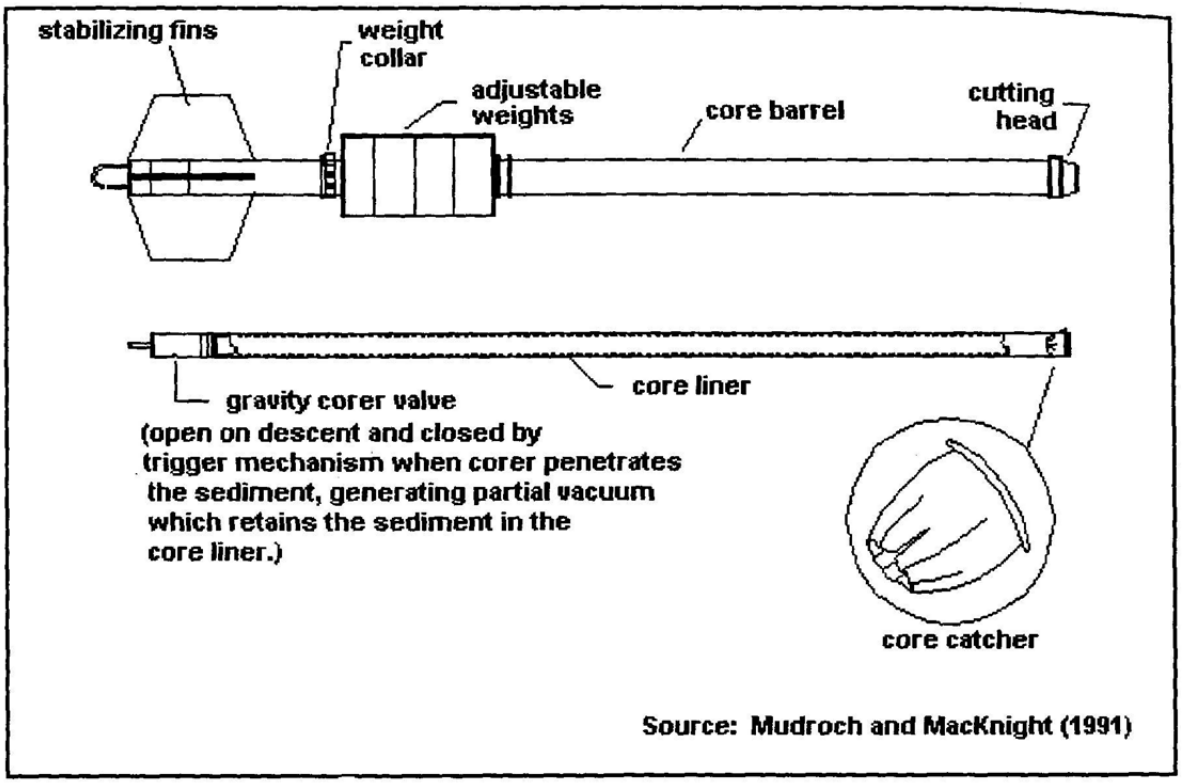

Figure 4. Typical Gravity Core Sampler

Small gravity corers can be operated from small- and medium-sized boats by hand or with a winch. Best performance is found where the corer is allowed to freefall between 2-3 meters (Mudroch and MacKnight 1991). Gravity corers can collect up to 2 meters of soft sediments, and are not suitable for hard or consolidated sediments. Sample recovery and vertical integrity are variable.

Box core samplers: Box corers are gravity corers designed for collecting large rectangular sediment cores of the upper 50-cm sediment layer (Mudroch and MacKnight 1991). A typical box corer is shown in Figure 5. Small box corers, weighing about 30 pounds, are equipped with additional weights (up to 100 pounds) to improve penetration. Much larger box corers, up to 2m x 2m and weighing 800 kg, have been fabricated (Mudroch and MacKnight 1991). The corer is lowered to the bottom by a cable with little freefall, and then triggered with a messenger. Small box corers may be operated from a boat with a winch.

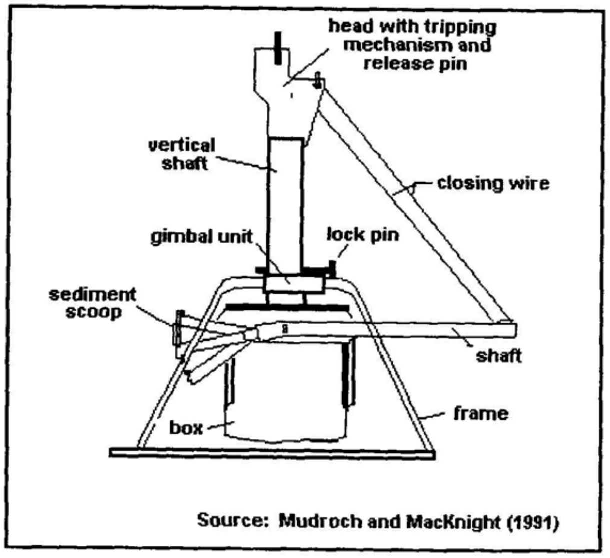

Figure 5. Box Core Sampler

Vibracore: The vibracore is a long continuous tube that is driven into the sediment using vibrating action, typically of a pneumatic impactor, as shown in Figure 6. The entire core is withdrawn, at which point the entire sample can be extruded and subdivided, or the tube may be cut into segments for sample extraction later. The vibracore can be operated from a small floating plant or barge with a tripod or small derrick and winch to assist in raising and lowering. Vibracores are typically 2-4 inches in diameter.

The vibracore is only suitable for unconsolidated sediments, particularly sandy sediments. They cannot penetrate most consolidated or coarse materials. Cores can be equipped with a catcher or the tube driven into a layer of compacted material, which forms a “cap” at the bottom. The vibration of the tube has been known to consolidate the sample. The vertical integrity of vibracore samples may be disturbed. Vibracores are well suited for the collection of samples to be vertically composited.

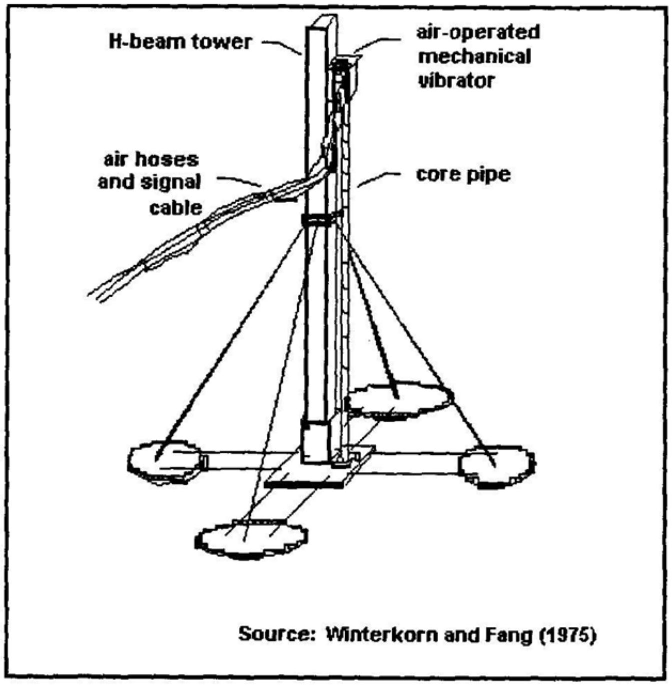

Figure 6. Vibracore

Split-spoon: The split-spoon sampler is basic equipment for geotechnical exploration of unconsolidated soils. The sampler is a metal cylinder which is divided in half, lengthwise, as shown in Figure 7. The two halves of the spoon are held together by small pieces of threaded pipe at each end. An open cap with a catcher is screwed on the tip. The sampler is attached to lengths of steel rod and driven into the sediments with a hammer or weight. After the sampler is withdrawn, the front and rear end pieces are unscrewed, the sampler opened, and the sample removed with a spoon.

Split-spoon samplers can be used for most types of sediments, including consolidated sand and clay. Recovery is variable, sometimes poorer with soft, fine-grained sediments. Split-spoon samplers are typically 2-3 inches in diameter, and available in from 2-5 feet. Successive vertical samples can be taken by driving casing (typically a 5-inch pipe) and cleaning out the drill hole between samples, as shown in Figure 7. The vertical integrity width of an individual split-spoon sample is variable, but a vertically composited sample can be obtained between two elevations with accuracy.

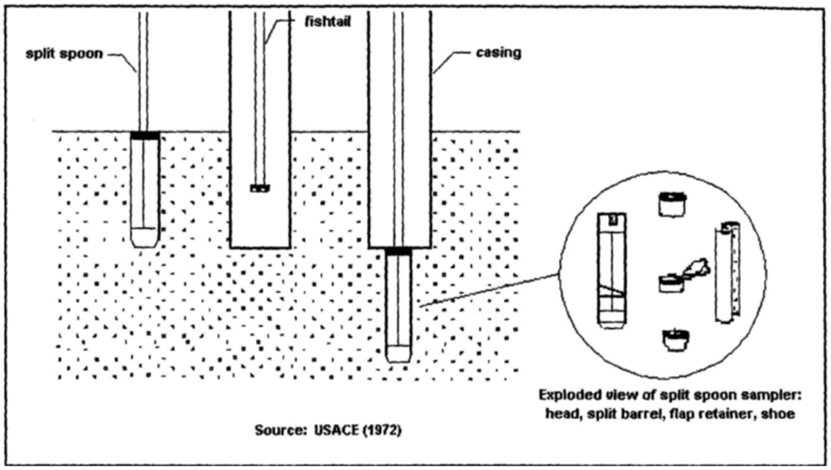

Figure 7. Split-Spoon Sampler

Piston samplers: A number of samplers use a thin metal tube that is extended forward under hydraulic force. These include the thin-wall stationary piston sampler, Lowe-Acker stationary piston sampler, and the Osterberg (as shown in Figure 8), and McClelland piston samplers (Winterkorn and Fang 1975). Piston samplers can be operated from a variety of drill rigs on small floating plants. The sampler, with tube retracted, is attached to a steel rod and pushed into the sediments to the desired starting depth. The hydraulic force is applied (water pump) and the tube extended. The sediments in the tube are held in a partial vacuum, and the assembly withdrawn. The tube is removed and the sediments extracted.

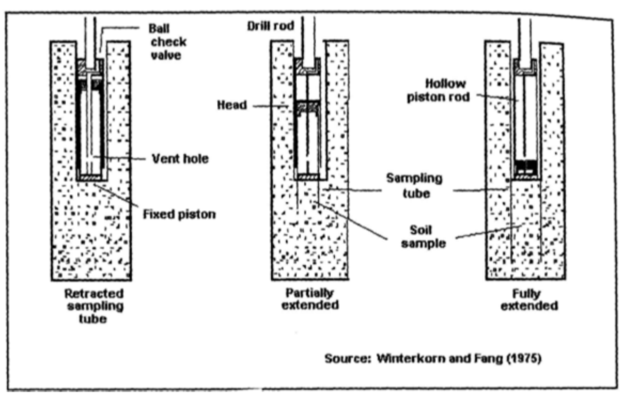

Figure 8. Piston Sampler

Piston samplers are suitable for soft, unconsolidated sediments. The sampler can penetrate some consolidated fine-grained sediments, but not coarse materials. Recovery with soft, fine-grained sediments is excellent. Sampler tubes are typically 3-4 inches in diameter and 3 feet long. The vertical integrity of individual samples is variable, but a vertically composited sample can be obtained between two elevations with accuracy, and without the need for casing.

3.2 Supporting Equipment

The size and complexity of supporting equipment varies for the different samplers. Most supporting equipment requires experienced operators. Some require a crew of several persons. Information will be provided on marine equipment, cranes, and drilling rigs. Information on marine equipment, cranes, and drilling rigs needed to support sediment sampling activities is summarized in Table 3.

3.2.1 Marine Equipment

Almost every size and type of boat, barge, and floating platform have been used for sediment sampling at one time or another. The suitability of a boat or floating platform is determined by the size and operating requirements of the sampler and the physical restrictions of the sampling site(s). These site restrictions include:

- water depth
- wave/tidal/current conditions
- accessibility.

Equipment availability and cost may also be important factors in the selection of supporting equipment. For example, if a marine construction contractor is already mobilized near the sampling site, it may be more cost-effective to rent the contractor’s equipment, even though it is larger than needed for sampler operation. In all cases, safety must be the overriding consideration in the selection of supporting marine equipment.

Boats: Small boats with outboard motors may be suitable for supporting some small clamshell dredge samplers and drag-line samplers in small tributaries and nearshore waters. Larger boats with an electric or hand-crank winch are suitable for supporting larger clamshell dredge samplers, small gravity core samples, and small box corers. Pontoon boats are suitable for supporting all grab samplers (except crane-operated clamshell buckets), hand-held cores, and gravity and small box cores.

TABLE 3. SUPPORTING EQUIPMENT FOR SEDIMENT SAMPLING

Equipment	Applicability	Crew[1]
Small boat (< 16 ft)	For use with handheld or winch-operated dredge, box, or gravity core samplers. Suitable for shallow conditions.	Operator (1)
Large boat	For use with handheld or winch-operated dredge, box, or gravity core samplers. Suitable for near-shore conditions.	Operator and mate (1-2)
Pontoon boat	For use with handheld core, dredge, box and gravity core samplers. Suitable for calm waters only.	Operator (1)
Collapsible drill rig	For use with split spoon or piston samplers on small barge.	Driller and helper (2)
Truck-mounted drill rig	For use with split spoon or piston samplers on larger barge.	Driller and helper (2)
Skid-mounted drill rig	For use with slit spoon or piston samplers. Suitable for clam waters and moderate depths.	Driller and helper (2)
Crane, 20-ton	For use with clamshell dredge bucket, to mobilize sectional barge, or to lift spuds.	Operator (1)
Small sectional barge	For use with collapsible drill rig. May require supporting vessel for propulsion. Suitable for clam waters and moderate depths.	Operator (1)
Spud barge	For use with truck-mounted drill rig or crane. May require supporting vessel. Suitable for near-shore and depths to 30 feet.	Operator and mate (2)

1 Crew size of combined equipment may be reduced if crew perform multiple duties. For example, if barge operator also operates crane.

2 Costs are for planning purposes only.

Sampling boats should generally be anchored at stations as best possible for safety and sample collection proficiency reasons. Some grab samplers will not function properly when drift causes them to strike the bottom of an angle less than perpendicular. Anchoring is an especially important safety consideration when divers are operating the sampling devices.

A qualified boat operator and sampler operator are the minimal crew for most small boats. Larger boars, suitable for work in the lake or large tributaries, may require additional crew members.

Floating platforms: A variety of barges, skiffs, and marine floating plants can be used for supporting larger sampling equipment. The selection must consider the size and weight of other supporting equipment (crane or drill rig) and the need to be stationary. Some barges and skiffs are self propelled, others require boats or small tugboats for propulsion. Crew sizes range from two to four.

If core sampling equipment is used, it is necessary to keep the sampler position laterally stationary. There are only a few methods of holding a barge, skiff, or floating plant in place at the sampling site. Anchoring is not always reliable in keeping a large vessel in place, except under very calm water conditions. If the sampling location is immediately next to land, the vessel can be tied to available structures.

The most reliable method of stabilizing a barge, skiff, or floating plant is the use of spuds, as shown in Figure 3. Spuds are long steel posts which are lowered into the sediments, typically at each end of the vessel. Some vessels have spuds which are hydraulically lifted, while others have them lifted with a crane on deck. On some small, sectional, spud barges, the spuds are lifted by hand.

3.2.2 Cranes and Drill Rigs

Cranes are used to operate clamshell dredge buckets and/or to lift spuds on floating plants. A crane must also be used to place a barge or floating plant into the water.

Many types of drill rigs are used in geotechnical explorations (Winterkorn and Fang 1975), but only the smaller, collapsible varieties have been routinely used for dredged material sampling at sites on the Great Lakes. A drill rig is basically a vertical frame or scaffold used to hold long lengths of pipe or core steady as they are lowered, raised, connected, and disassembled.

A-frame and tripod drill rig assemblies are small, collapsible, and can be assembled on very small barges. A truck-mounted drill rig, commonly used in drilling potable water supply wells and installing monitoring wells, has a collapsible rig mounted on a truck. Truck-mounted drill rigs can be driven onto barges or floating plants and chained to the deck. Drill rigs can operate through a hole in the barge or floating plant (if available), or over the side. Small drill rigs are typically operated by a driller and a helper (crew of two).

4.0 GUIDANCE ON FIELD ACTIVITIES

4.1 Location Stationing

4.1.1 Horizontal Positioning

The location of a sampling station needs to be determined both horizontally and vertically. The precision of location stationing will vary with the requirements of the sampling plan and site conditions. Depending on requirements and conditions, it may be adequate to position sampling stations visually, without instrumentation, using available landmarks for reference. Generally, this is only appropriate in small rivers or in harbor locations near (< 50 feet) land, piers, or breakwaters.

Positioning of stations in larger rivers, open harbors, or the nearshore lake should be done using some type of instrumentation. A variety of instruments may be used, including land survey equipment, Loran, and global positioning systems (GPS). Most commercial navigation vessels and larger recreational crafts are equipped with Loran, while GPS is becoming more commonly available. If stations are positioned by a dedicated survey team, it will be more cost efficient to have all stations located and marked with buoys on one day rather than to have the survey team stay for the duration of sediment sampling.

4.1.2 Vertical Positioning

Location positioning should include the elevations of the water surface and sediment-water interface. This is especially important for dredging projects. Since sediments are typically dredged to a fixed elevation, a sample collected below this elevation would not be part of the material to be dredged. Water depth can be determined using a lead line, sounding basket, or bathymetric instrumentation. Because all water surfaces fluctuate over time, the water surface elevation must be referenced to a fixed datum.

The accepted elevation datum for the Great Lakes is the International Great Lakes Datum (IGLD), which is referenced to the zero point at Rimouski, Quebec. This datum was adjusted in 1955 and again in 1985 to account for movements of the earth's crust (Coordinating Committee on Great Lakes Basin Hydraulic and Hydrologic Data 1992). Conversions between IGLD 1955 and other elevation datum are summarized in Table 4.

Low water Datum (LWD) are the planes of reference to which most Great Lakes navigation charts are referenced. The LWD elevation reflects the average low water elevation of the individual lakes. The Low Water Datum elevations of each of the Great Lakes referenced to IGLD 55 and IGLD 85 are shown in Table 5.

TABLE 4. ELEVATION CONVERSION CHART

Given	To Find				
	CCD[1]	IGLD 55	MTNY[2]	MSL[3] 1912	MSL 1929
CCD		+ 578.18	+ 579.88	+ 579.91	+ 579.48
IGLD 55	- 578.18		+ 1.70	+ 1.74	+ 1.30
MTNY	- 579.88	- 1.70		+ 0.04	- 0.40
MSL 1912	- 579.91	- 1.74	- 0.04		- 0.44
MSL 1929	- 579.48	- 1.30	+ 0.40	+ 0.44	

1 Chicago City Datum
2 Mean Tide New York
3 Mean Sea Level

TABLE 5. LOW WATER DATUM FOR IGLD 85

Lake	IGLD 55 (feet)	IGLD 55 (meters)	IGLD 85 (feet)	IGLD 85 (meters)
Lake Superior	600.0	182.9	601.1	183.2
Lake Michigan	576.8	175.8	577.5	176.0
Lake Huron	576.8	175.8	577.5	176.0
Lake St. Clair	571.7	174.2	572.3	174.4
Lake Erie	568.6	173.3	569.2	173.5
Lake Ontario	242.8	74.0	243.3	74.2

Water surface elevations may be referenced from survey markers installed by the USACE or other agencies, or from fixed structures that have been surveyed and elevations recorded. USACE survey markers are small (3 1/2" diameter) brass plates, placed at locations around authorized navigation projects. Their locations and elevations can be obtained from the appropriate USACE district office. Water levels can be obtained from recording gages maintained at selected sites on the Great Lakes (NOAA 1992a), although these are not as representative as “on-site” measurements and should be used only as a last resort.

Bridges are often used to reference water level elevations. The elevation of low steel, the lowest point of the bridge span, is available for many bridges from city or state highway departments, railroads, port authorities, and the USACE. Bridge clearances, to the nearest foot above LWD, are also published in the “Coast Pilot” (NOAA 1992b).

4.2 Sample Collection

There are many reasons why slow methodical collection protocols are best, not the least of which is safety. Taking extra time to be sure that the vessel is on station, the proper sampling device is outfitted with the correct attachments, the correct jars and labels are being used, the proper methods of sample splitting and mixing are being deployed, and all activity and conditions are fully documented in the sampling log can save having to repeat these activities.

Because of the complexity associated with sediment sampling, it is always good practice to assign all team members specialized responsibilities. Further, a single lead team member should work with the vessel operator and oversee all sampling and handling activities. This team leader is usually also responsible for documenting the field work in the sampling log.

A field log should always be prepared to describe the conditions and events of the sediment sampling project. The EQ boring log is provided in Attachment 1. Field logs should document conditions of the sampling locations, elevations of the water and sediment surfaces, information about the sampling equipment, and sample recovery. The logs should also record the physical appearance of the sediment sampled. Categories of sediment characteristics are listed in Table 6. Photographs of the sample are another way to document physical appearance.

TABLE 6. CATEGORIES OF SEDIMENT CHARACTERISTICS

Type	Size or Characteristic
Inorganic Componets[1]	
Cobbles	75 to 300 m (3 to 12")
Gravel	4.75 to 75 mm (3/16 to 3")
Sand	0.075 to 4.75 mm
Silt	0.005 to 0.075 mm in diameter
Clay	< 0.005 mm; smooth, slick feeling when rubbed between fingers
Organic Components[2]	
Detritus	accumulated wood, sticks, and other undecayed coarse plant materials
Fibrous peat	partially decomposed plant remains; parts of plants readily distinguishable
Pulpy peat	very finely divided plant remains; parts of plants not distinguishable; varies in color from green to brown; varies greatly in consistency–often semi-fluid
Muck	black, finely divided organic matter; completely decomposed

1 Unified Soil Classification System
2 USEPA (1973)

All sampling and field measurement equipment should be checked and tested before leaving shore. Sampling equipment (the parts which contact the sediment sample) should be cleaned before the sampling project and in-between project samples. Recommended pre-project cleaning procedures are as follows:

- wash with non-phosphate detergent
- triple rinse with distilled water
- rinse with acetone
- rinse with reagent-grade hexane
- air dry.

In the field, sampling equipment should be cleaned between samples to avoid cross-contamination. Although the above cleaning procedures are appropriate, the use of acetone and hexane on some sampling vessels or with some sampling equipment may be infeasible or present safety problems. The following are minimum cleaning procedures between samples:

- brush and wash with site water
- rinse with distilled water.

4.3 Sample Handling and Containers

Sediments should be removed from samplers and handled using non-contaminating equipment. In most cases, stainless steel spoons and bowls which have been cleaned in the same manner as the sampler are appropriate. One very common mistake made during sediment sample handling is pouring off "excess water." This water and the fine particulates suspension are part of the sample. Discarding it may bias the sample.

Homogenization, or mixing of a sediment sample in the field, is not necessary in most circumstances. If the sediment sample is to be analyzed by a single laboratory, homogenization can be conducted at the lab under more controlled conditions. In cases where the sample is to be divided into two or more containers for shipment to different laboratories, sample homogenization can be conducted in the field, or the entire sample can be shipped to one laboratory, where the sample is homogenized and aliquots are shipped to other labs. Laboratories should be given specific instructions about sample homogenization and notified that water in sample containers should not be discarded, but homogenized with the sample.

Homogenization in the field may be appropriate where the volume of sample collected is far greater than the volume to be transported, and the intent is to have the sample placed in the containers representative of the whole sample collected. In this case, slow and smooth mixing techniques should be used. Overmixing may cause spillage and aeration of the sediment sample, which may alter the sediment chemistry. The larger the volume of a sediment sample, the more difficult it will be to mix the sample in the field. Samples must be protected from external sources of contamination, such as boat splash and fuel and lubricants, during handling.

Sediment samples should be placed into containers and stored at 4° C as rapidly after collection as possible. Containers should be filled to the top with the sample, leaving no head space.

Containers for sediment samples should be made of clean, non-contaminating materials. If the sediment sample were solely for a specific type of chemical analysis, it might be appropriate to choose the container materials which avoid contamination or bias. Since most sediment samples for 404(b)(1) determinations are intended for a variety of analyses, and because of the difficulty in ensuring the sub-samples prepared in the field are homogeneous, it is recommended that samples be contained in one type of container for transport to the laboratory, where the sample can be homogenized and subdivided.

Recommended container materials include wide-mouth glass jars with Teflon-lined caps and high-density polyethylene (HDPE) plastic buckets with lids. Each has its advantages and disadvantages. Glass jars are available in a variety of sizes, and are most suitable for smaller sample volumes (1-4 liters) needed for bulk chemistry, grain size analysis, and elutriate tests. Glass jars require considerable care in packing and transport, and can break despite the best precautions. HDPE plastic containers are available in small and large sizes, including 5-gallon tubs which are well suited to the large-volume samples needed for toxicity, bioaccumulation, and column settling tests. Sample containers and lids should be cleaned as follows:

- wash with acid (chromic or HCl)
- rinse with distilled water
- wash with non-phosphate detergent
- triple rinse with distilled water
- rinse with acetone
- rinse with reagent-grade hexane
- air dry.

New containers from laboratory supply companies are generally cleaned to the above or better specifications. New containers from bulk supply companies may need to be cleaned before use.

Sample containers must be identified unambiguously, and a precise sample labeling and coding system should be developed prior to field work to avoid costly mistakes. It is recommended that sampling jars and vessels be pre-labeled, as field conditions are often wet and bumpy, and labels can become scribed indelibly. Labels must be able to withstand the condition of transport and storage without deterioration or becoming loose. Labels on glass jars stored in wet ice have been known to become "unglued" in transport. To prevent such problems, glass jars may be placed into plastic bags and sealed (this also helps control the mess if a jar breaks in transport). Plastic containers can be marked with indelible pens or markers in addition to regular labels, as a safeguard. Examples of labels are provided at Attachment 2.

4.4 Sample Transport

Sample containers should be packaged for transport in a manner that maintains them at 4° C and protects them from breakage or spillage. A variety of packing materials and containers are available specifically for the transport of environmental samples. Considering the costs of sample collection and analyses, these materials are a sound investment.

There are a number of transport modes for sediment and water samples. Most overnight transport carriers will accept environmental samples, provided they are in secure containers. Some carriers will not accept wet ice, and most will not accept dry ice. Packaged refrigerants ("blue ice") are accepted by most carriers. When large samples are collected (several 5-gallon tubs), it may be more cost-effective to lease a refrigerated truck or contract a specialized carrier. The temperature of samples should be measured and recorded at the time of arrival in the laboratory.

Procedures for documenting chain-of-custody for dredged material samples are recommended. The EQ chain-of-custody record is provided as Attachment 3.

4.5 Health and Safety

Worker health and safety must be a paramount consideration during all sediment sampling activities. Corps districts require that their boat operators complete certified training from the U.S. Coast Guard and that their divers be certified and follow the procedures in the U.S. Navy Diving Manuals (U.S. Navy 1988).

Most rivers have numerous crossings by utilities buried beneath the river bottom, and in some cases exposed on the sediment surface. These include water and sewer pipelines, gas and petrochemical pipelines, and electrical and telecommunications cables. Navigation charts typically show utility crossings, but are not always complete or up-to-date. Developers of sediment sampling plans should contact the appropriate utilities to confirm the presence and locations of crossings, especially when any drilling is planned.

Each crew member should be fully outfitted with appropriate safety equipment and properly fitted clothing. Provisions should also be made for staff to clean up during and after sampling. Soaps, brushes, sponges, water, and change of clothing should be available when appropriate. Rain- and weather-protective clothing and life vests are always appropriate for on-board stowage.

In general, sediments that are being considered for open-water disposal will not contain sufficient levels of contamination to require sophisticated personal protective equipment (PPE). Workers should avoid any dermal contact with sediments, and all sampling equipment should be handled with protective gloves. With more contaminated sediments, disposable Tyvecc clothing should be worn.

Pre-planning for sediment sampling should identify the location and telephone numbers of emergency assistance, including police, Coast Guard, marine assistance, and hospital emergency service. This information should be readily available to the entire field crew.

4.6 Environmental Compliance

The USACE has issued nationwide permits under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act for minor dredging and discharge of quantities less than 25 cubic yards (Federal Register, November 21, 1991). In most instances, sediment sampling for testing purposes will be covered by these nationwide permits, and no separate permits required under these authorities. In cases where sampling is conducted in waterways adjacent to private property, the rights of riparian owners should be considered.

The disposal of field-generated waste, other than excess sediment samples, is regulated by Federal, State, and local laws and regulations.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Most of the specific quality control procedures that are appropriate for sediment sampling and handling have been described, including recommended sampling protocols, methods for cleaning sampling equipment and containers, sample handling, and transport. The written sampling plans should identify the specific methods to be employed and the rationale for variances from the guidance provided here.

Detailed written protocols or standard operating procedures (SOPs) should be developed and used for field collection activities. Equipment used for making field measurements (e.g., bathymetric survey equipment) should have a quality assurance plan which includes schedules and procedures for calibration, maintenance, and repair. Operators should be familiar with these plans and trained in equipment use and operation.

Field blanks are not generally necessary for dredged material evaluations, and field replicates are not considered useful indicators of QC for sediments.

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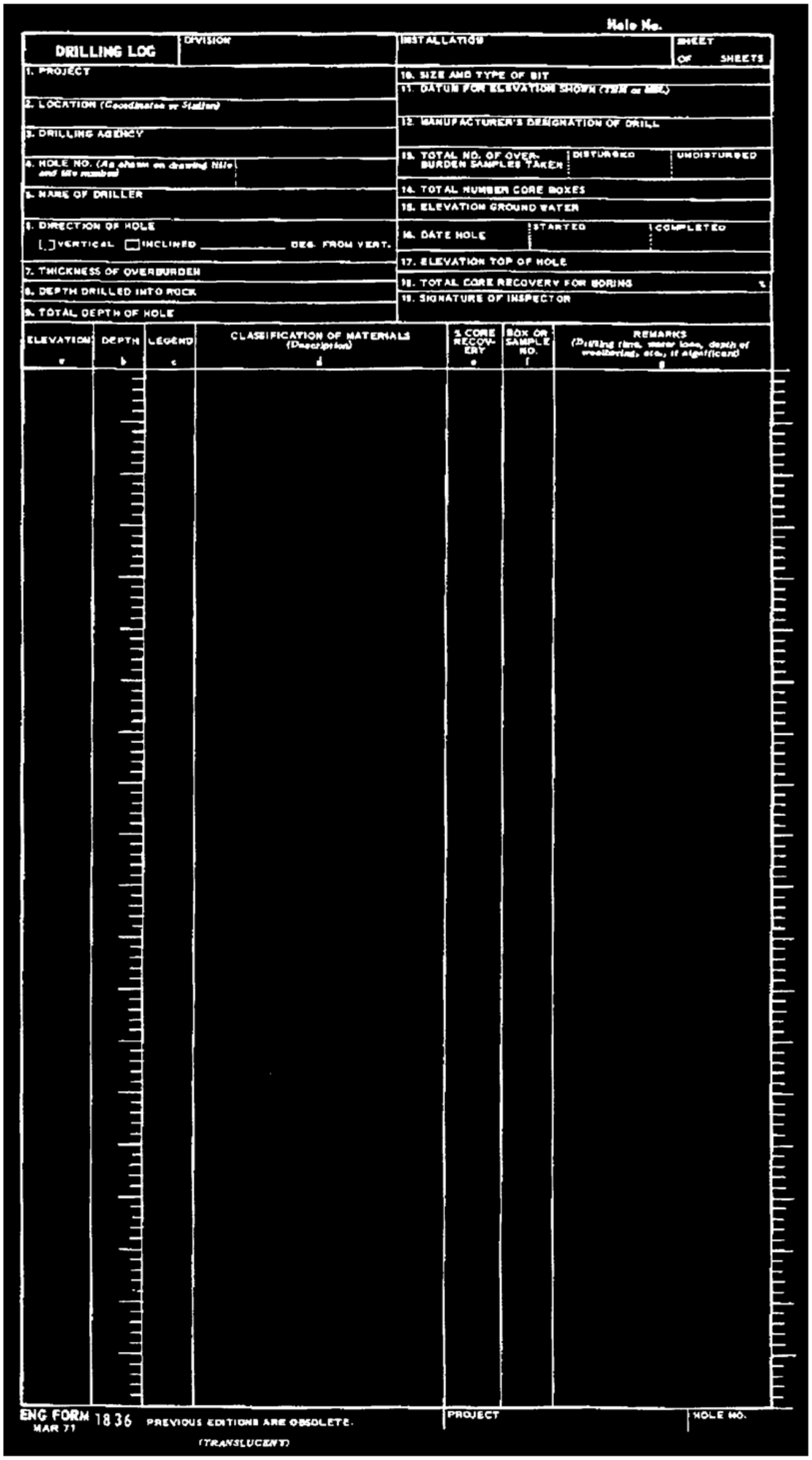
ATTACHMENT 1



Hole No.

DRILLING LOG	DIVISION	INSTALLATION	SHEET OF SHEETS
1. PROJECT		10. SIZE AND TYPE OF BIT	
		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
2. LOCATION (Coordinates or Station)			
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
		15. ELEVATION GROUND WATER	
6. DIRECTION OF HOLE [ ] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.		16. DATE HOLE	STARTED / COMPLETED
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	%
9. TOTAL DEPTH OF HOLE		19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT HOLE NO.

ATTACHMENT 2

ATTACHMENT A
Sample Label and Custody Seal

Sampler/Affiliation: EQ__________

Site: ____________________

Sample ID: ____________________

Date: ________ Time: ________

2505

CUSTODY SEAL

Person Collecting Sample ____________________ Sample No. __________
(signature)

Date Collected ____________________ Time Collected ________ 2505

ATTACHMENT 3

1800 Carillon Blvd
Cincinnati, OH 45240
(513) 825-7500

Environmental Quality Management, Inc.
Chain of Custody Record

COC Tracking: **EQ-10000**

Project No.	Project Name		
Samplers/Affiliation: *(Print Name and Sign)*		Lab P.O. No:	

Sample ID:	Date	Time	Description/Matrix:	Sample Volume / Comments	No. of Containers	TESTS											

Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Ship To:
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Airbill Number

Reporting/QA Requirements:	Turn Around Time (***EXACT DUE DATE***):	Report To:	Chain of Custody Seal Numbers

Distribution: White - Accompanies Shipment Pink - Project Files Yellow - Laboratory File

Environmental Quality Management, Inc.

Standard Operating Procedure

Title:	**Surface Soil Sampling**	**Document No.**	**SP-Soil-4**
Date of Issue:	**September 2009**	**Revision No.**	**4**
Point of Contact:	Aaron Roski, Environmental Chemist	**Approval:**	Jackie Doan, Corporate QA Director

1.0 OVERVIEW

This procedure describes the technique for collecting soil samples from the ground surface, or slightly below the surface, in vegetated and non-vegetated areas. This SOP applies to most assessment and remedial sampling activities, including stockpiled soil, pits, and trenches.

Information on proper sampling equipment, materials, and supplies to facilitate the planning of surface soil sampling events is provided through general information, related documents, definitions, responsibilities, standard procedures, and a list of equipment, materials, and supplies.

2.0 RELATED DOCUMENTS

The following documents are available in EQ's Library for reference and review.

- Compendium of ERT Soil Sampling and Surface Geophysics Procedures, (EPA/540/P-91/008).
- Description and Sampling of Contaminated Soils, Field Pocket Guide (EPA/625/12-91/002).
- Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup, (EPA-560/5-86-017).
- Handbook to Support the Installation Restoration Program (IRP) Statements of Work: Volume I - Remedial Investigations Feasibility Studies (RI/FS), Air Force Center for Environmental Excellence, Brooks AFB, TX (ADA 262 132).

- Environmental Quality Management's Standard Operating Procedure (SOP) SP-Soil-2.
- Preparation of Soil Sampling Protocol: Techniques and Strategies (EPA 600/4-83-020).
- Soil Sampling Quality Assurance User's Guide (EPA 600/4-84-043).
- Environmental Quality Management's Standard Operating Procedure (SOP) SP-Othr-1.

3.0 GENERAL INFORMATION

3.1 Sample Integrity

Proper handling, preparation, packaging, and shipment of soil samples are of extreme importance and can greatly affect the results of the sampling event.

- Samples should be placed in sample containers immediately after collection. When composite samples are being collected, the sample container or mixing bowl should be covered between collection of subsamples.
- Samples to be analyzed for volatile organic compounds should be collected in a manner that is least disruptive to the soil matrix and should not be mixed after collection or during packaging. These samples must be tightly sealed in containers and stored at $\leq$ 4° C immediately (refrigeration is preferred to cooler with ice).
- Samples should not be exposed to direct sunlight after collection.
- All samples should be stored, immediately after collection, at 4° C.

3.2 Compatability

Sampling devices should be constructed of materials that will not affect the analytical results of the target analytes or contaminants of interest.

- Sampling devices constructed of relatively inert materials (i.e., Teflon, stainless steel, and glass) are the most desirable and are generally acceptable for most soil sampling activities.
- Devices constructed of wood, chrome, or nickel-plated steel, and brass should be avoided since these materials can adsorb analytes

or can react with the soil and affect the analytical results. Note that most garden tools such as trowels, bulb planters, and such are plated with chrome. Similarly, brass tools are constructed of a copper and zinc alloy.

- The sampling devices should not leave residues in samples that will interfere with analyses of the samples.

3.3 Cross-Contamination

Soil samples can be cross-contaminated by sampling devices that are not properly cleaned before and/or after use.

- New, disposable, dedicated, or pre-cleaned sampling devices should be used to collect each individual soil sample.

- If the same sampling device will be used to collect more than one sample during a sampling event, it must be cleaned (decontaminated) before each sample is collected.

- The sampling scheme should take into account sampling from the most contaminated to the least contaminated.

3.4 Sample Representativeness

Extreme care and caution should be taken to avoid the introduction of variables during sampling collection, preparation, and handling.

- Uniform sampling techniques and handling procedures are greatly important when collecting a group of samples to be analyzed for the same parameters.

- Deviations in the technique, preparation, or handling of samples, from sample to sample, may affect the sample results particularly when the results for the sample group are going to be compared or are to be used for confirmation purposes (i.e., extent of contamination, post-cleanup verification, etc.)

- Sample compositing or mixing should be duplicated precisely from sample to sample.

- Sample containers should be placed uniformly with equal amounts of soil from each sample location.

- Square grid, radial grid, or random sampling (self-directed or otherwise) systems are typically used. The specific sampling locations are predetermined, in most cases, by the project design team, during preparation of the project-specific plans.

- The number of samples to be collected are predetermined, in most cases, by the project design team based on statistical calculations or models to assure that the data accurately represents the actual conditions of the soil being sampled.

3.5 Distribution of Analytes/Contaminants

Soil type and characteristics (i.e., moisture content, grain size, sand/silt/clay, glacial till, topsoil, organic/peat materials, etc.), level of contamination (i.e., trace versus gross concentrations of target analytes), and many other factors affect the distribution of analytes or contaminants in the soil matrix.

- The soil matrix itself may be non-homogeneous.

- The analytes and/or contaminants may be non-homogeneous in the soil matrix except when gross levels or concentrations are present (i.e., free-phase petroleum or solvents that have saturated the soil matrix), and the soil matrix is uniform.

- Complete documentation of the sampling event and field observations may dictate modification to the sampling design or approach based on the objective of the sampling event.

4.0 DEFINITIONS

Soil Sample - Soil collected to determine the physical, chemical, biological, or other necessary characteristics through field or laboratory screening, measurements, or analyses. Soil samples usually do not require DOT hazardous material labeling for shipment.

5.0 RESPONSIBILITIES

5.1 Sample Team Leader

- Reports directly to the Project Manager.

- Thoroughly reads and implements the project- and program-specific plans.

- Responsible for all aspects of the sampling event including the Health and Safety of the sample team.
- Directs the Sample Technicians during preparation for and implementation of the sample event.
- Interfaces with Lab Coordinator for analytical laboratory services.
- Maintains physical custody of samples until they are transferred off site or to an on-site laboratory.

5.2 Sample Technician

- Reports directly to the Sample Team Leader.
- Prepares and dispatches sampling equipment and supplies to the site.
- Sets up sample control, storage, and equipment/personnel decon areas.
- Assists with sample collection, preparation/preservation, packaging, and labeling.
- Stores samples, completes chain-of-custody forms, maintains control of samples, and ships to lab or transfers custody to third party.
- Assists with field documentation (i.e., sample logs and maps, and marks sampling locations, etc.).
- Decontaminates sampling devices and related equipment.

6.0 PROCEDURES

Surface soil samples are typically collected by hand using shovels and spoons or scoops. The uppermost surface material (any vegetation and approximately 1 inch) is normally removed prior to collection and recovery of the actual soil sample. When the area to be sampled cannot be safely accessed for sample collection by hand (i.e., trenches, pits, boggy areas, etc.), heavy equipment such as backhoe or trackhoe may be used to safely reach and scoop soil from the desired locations. When heavy equipment is used, extreme care should be taken to avoid collection of soil that contacted the side or teeth of the excavator bucket.

Soil samples that are below surface coverings to include construction covers such as asphalt and concrete (i.e., flooring, road surfaces, sidewalks, etc.) will require additional preparation prior to sampling. Removal of construction covers may include the use of coring devices or heavy equipment. Care will be needed if heavy equipment is used, so as not to remove soil intended to be sampled.

The representativeness of soil samples collected, using this sampling technique, depends heavily on the accuracy with which this technique is employed. The Sample Team Leader or Sampling Technician(s) must use extreme care and precision during sample collection activities and should avoid variance in the actual collection technique from sample to sample.

The remainder of this section provides a step-by-step listing of the surface soil sampling procedure.

6.1 Office Preparation

- Review all Project Plans (i.e., Work Plan, Sampling and Analysis Plan, Field Sampling Plan, Quality Assurance Project Plan, Health and Safety Plan, and other project-specific plans).

- Meet with Project Manager and Lab Coordinator to address any questions and discuss project budget and schedule.

- Coordinate and make advance notifications, as required, to all necessary or involved parties (i.e., support staff, technicians, site, client, regulators, etc.).

- Prepare and distribute list of equipment, materials, and supplies to accomplish the sampling objectives.

- Accumulate, assemble, check out, and package all listed equipment, materials, and supplies for dispatch to field.

- Mobilize the site.

6.2 Field Preparation

- Arrive on site, introductions, site orientation, review and signoff of Health and Safety Plan, complete safety orientation, and obtain necessary permits.

- Procure field purchase/expendable items (i.e., ice, plastic bags, film, etc.) and locate courier services (i.e., Airborne, Federal Express, etc.), as necessary.

- Conduct initial survey of area to be sampled using site map with identified sample locations, and identify onsite areas for preparation and setup of sampling equipment, equipment/ personnel decon, and sample storage.

- Prepare equipment, materials, and supplies. Set up decon and sample storage areas.

- Don required PPE, complete sampling grid (if necessary), and locate, measure, and mark sampling points. Return to personnel decon area, remove PPE, and make remaining field notes in log and on site map.

- Calculate total number of samples and duplicate samples for first area to be sampled. Decon sampling equipment following decon procedure specified in the project plans, and prepare material and supplies to initiate sampling activities.

6.3 Sample Collection

- Don required PPE for sampling and proceed to first sampling location.

- Use clean surgical gloves to collect each sample (except during preparation of composite samples).

- With precleaned shovel, carefully remove any vegetation and uppermost layer of soil (approximately 1 inch) from small area immediately over sample location.

- With precleaned or new stainless steel spoon or scoop, remove and discard thin layer of soil from the sample area that came into direct contact with the shovel.

- Using a precleaned or new stainless steel spoon, scoop, or hand-coring device, collect soil sample from the area and transfer to appropriate sample container(s). Place lid on sample container(s), remove any excess soil from the exterior of the container, tightly seal, and label. Place sealed container(s) in plastic ziplock bag(s), and immediately store in sample cooler on ice. Complete sample log sheet and document appropriate field observations in site log.

    - If heavy equipment (i.e., backhoe) is used for sample collection, follow same procedure as above being sure to collect sample from center of backhoe bucket in undisturbed soil. Sample Technician must work closely with Backhoe

Operator to assure that the procedure is understood. If the soil in the bucket has been disturbed during excavation, discard the entire bucket of soil, direct the Operator to scoop soil from an undisturbed location immediately adjacent to the initial location, recover sample, and document actual sample location on sample and field logs.

- If composite samples are being collected, place each individual sample in a stainless steel mixing bowl or pan and thoroughly mix all samples together to obtain a homogeneous composite sample. After mixing, transfer the soil mixture in the appropriate container(s). This procedure should NEVER be used for samples to be analyzed for volatile organic.

- Soil samples for volatile organic analyses are not to be composited or mixed and each sample container should be filled completely (no headspace shall be present in the container), sealed, and immediately stored at approximately 4° C (refrigeration is preferable to cooler with ice). Measures should be taken to minimize holding time in the field and in the lab to reduce the potential for loss of volatile organic compounds.

• After sampling at each location, soil remaining on used sampling devices should be tamped off and left at the sample location. The surface material should be placed back over the area sampled and the sample location should be marked with stakes and flagging material.

• Reusable sampling devices should then be placed into plastic bags and transported back to the designated equipment decon area for cleanup prior to reuse.

• Equipment should be decontaminated according to the procedure specified in the Project Plans. General decontamination procedures are provided below:

    - Devices used for soil to be analyzed for inorganic compounds

        -- Prewash with Alconox and tapwater.

        -- Rinse with tapwater.

        -- Rinse three times with tapwater.

-- Rinse three times with distilled, deionized, or analyte-free water.

-- Allow cleaned sampling device to air dry and wrap in clean plastic.

- Devices used for soil sampling to be analyzed for organic compounds

  -- Prewash with Alconox and tapwater.

  -- Rinse three times with tapwater.

  -- Rinse three times with distilled, deionized, or analyte-free water.

  -- Rinse with pesticide-free laboratory-grade isopropyl alcohol, optional step.

  -- Allow cleaned sampling device to air dry and wrap in clean plastic.

- Disposable sample devices and spent PPE should be placed into plastic bags and transported to the personal decon area for proper disposal upon completion of the sampling event. Repeat the above steps until all samples are collected.

7.0 EQUIPMENT, MATERIALS, AND SUPPLIES

7.1 Documents

- Site map with sampling locations
- Work Plan
- Sampling Plan
- Quality Assurance Project Plan
- Health and Safety Plan
- Field Log Book(s)

7.2 Protective Equipment

- Minimum of Level D Personal Protection (hardhat, safety shoes, and glasses)
- Other PPE as specified in Health and Safety Plan
- Raingear and/or warm clothing, if necessary

7.3 Miscellaneous

- Keys for access to site and lubricant (WD40 or Graphite) for locks
- Bottled drinking water (or Gatorade®) for replenishment/fluid loss
- Notebook or paper, pencils, ballpoints, and markers (Sharpies)
- Clipboard with cover
- Cellular phone or portable two-way radios
- Calculator
- Camera and film
- Compass, thermometer, sling psychrometer, humidity gauge (as necessary)
- Flashlight and extra batteries
- Folding table
- Toolbox, including heavy/sledge hammer and bolt cutter
- Tape measure (type and size as needed)
- Razor knife
- Surveyors equipment (Transit/Level, steel tape and rod)
- Surveyors hardwood stakes and/or pins
- Flagging ribbon

7.4 Sampling Devices

- Shovel/spade
- Spoons (stainless steel)
- Scoops (stainless steel)
- Mixing bowls or pans (stainless steel)
- Backhoe or trackhoe and operator (if necessary)

7.5 Sample Materials, Containers, and Forms

- Sample containers (as specified in project plans, plus 20 percent)
- Sample labels and seals
- Sample log forms
- Ziplock plastic bags for sample containers and for protecting equipment that cannot be decontaminated (cameras, notebooks, etc.).
- Plastic trash bags for dirty equipment or trash

7.6 QA/QC Materials and Items

- Chain-of-Custody forms
- Lab request for analysis forms
- Shipping forms
- Trip Blanks

- Field and equipment rinseate blanks, field duplicates (project plans may call for these items to be prepared/collected during the sampling event)
- Ice chest or cooler for sample holding/shipment
- Ice

7.7 Decontamination Supplies

- Wash solution(s) - specified in project plans
- Rinse solutions (deionized water, acids, etc.). - specified in project plans
- PPE as necessary for decon (addressed in Health and Safety Plan)
- Tubs for decontamination
- Plastic sheeting
- Garden sprayers
- Brushes
- Kimwipes
- Containers and labels for rinseate/water/residuals

Environmental Quality Management, Inc.

Standard Operating Procedure

Title:	**Surface Water Sampling**	**Document No.**	**SP-Watr-7**
Date of Issue:	**January 2007**	**Revision No.**	**3**
Point of contact:	**(signature on file)** **Colleen Lear, Geologist**	**Approval:**	**(signature on file)** **Jackie Doan, Corporate QA Director**

1.0 OVERVIEW

This Standard Operating Procedure (SOP) describes the collection of representative samples from surface waters using various methods and sampling devices. This SOP is applicable for an assortment of environmental sampling scenarios including but not limited to pits, ponds, lagoons, excavations, lakes, creeks, and streams. Sampling equipment used in these sampling activities are listed in Section 6.0.

This SOP provides information on the proper equipment and techniques for sampling liquid materials. Reference documents, general information, definitions, responsibilities, standard procedures, equipment, and supporting data are provided to facilitate the planning and performance of sampling activities.

2.0 RELATED DOCUMENTS

For further information on sampling of liquid materials, refer to the *Compendium of ERT Surface Water and Sediment Sampling Procedures*, (EPA/540/P-91/005), *Test Methods for Evaluating Solid Waste, SW-846* (EPA/OSWER), *Handbook for Sampling and Sample Preservation of Water and Wastewater*, (EPA600/4-82-029), and *RCRA Ground Water Technical Enforcement Guidance Document*, (OSWER 9950.1).

3.0 TERMS AND DEFINITIONS

Grab sample - A single sample collected from a location/depth.

Composite sample - A sample comprised of a designated number of subsamples that have been combined. A composite sample represents the water’s overall composition.

Drainage - Natural or channelized streambed or storm runoff drainage channel.

Impoundment - Body of water created by a dam, berm, or other man-made structure.

Van Dorn sampler - Type of sampler used to collect a discrete sample at depth. A weighted “messenger” trips the end caps of a PVC tube to isolate a sample from the desired depth.

Kemmerer sampler - A sample collection device similar to a Van Dorn sampler. Used to collect a discrete sample at depth.

FSP - Field sampling plan.

OVA - Organic vapor analyzer.

OVM - Organic vapor meter.

PVC - Polyvinyl chloride.

QC - Quality control.

SOP - Standard operating procedure.

VOC - Volatile organic compound.

4.0 GENERAL INFORMATION

Liquid materials are often non-homogeneous and the distribution of contaminants is often stratified within the liquid layers. To offset these conditions during the sampling activities, the following steps are suggested:

- When surface water and sediment samples are colected from the same location, collect the water samples first.
- Determine the number and thickness of layers (if possible) in the sampling environment.
- When possible, use a systematic grid layout approach to collect a representative sample of the media being sampled.
- Maintain a detailed record of the sampling activities including but not limited to sample location, depths of materials, characteristics of the interval being sampled, viscosity, color, odor, and field instrumentation measurements if observed.

5.0 EQUIPMENT AND PROCEDURES

5.1 Equipment and Supplies

- Data sheets, maps, sample labels, and other documentation designated for the sampling activity.
- Sample containers and preservatives.
- Filtration apparatus (if samples are to be analyzed for dissolved constituents.)
- Coolers with ice.
- Field meters (pH, OVA/OVM, conductivity, dissolved oxygen, radioactivity, etc.) to conduct field measurements designated in the FSP.
- Weighted measuring tape for depth measurements.
- Decontamination supplies.
- Gloves.
- Van Dorn, Kemmerer, or automatic sampler as designated in the FSP.
- Stainless steel bucket or Teflon® beaker for mixing composite samples.

5.2 Procedures

Surface water sampling involves the following steps or activities: planning, recordkeeping/documentation, field and QC sample collection, and sample handling and shipment.

5.2.1 Planning

Planning for surface water sample collection involves:

- Selecting and visually sampling locations during FSP development. All sample locations should be clearly designated on site maps prepared using a scale that allows the field team to correctly locate each sampling point. If possible, locations should also be designated by northing and easting from obvious reference points (building corners, street intersections, monitoring wells). If not designated in the FSP, these measurements must be recorded during sample collection.

- Scheduling laboratory capacity and field staff prior to field activities. This should be done at least several weeks prior to the field effort.

- Acquiring needed sampling equipment and supplies.

- Compiling or developing data sheets and other documentation forms.

5.2.2 Sample Collection

The surface water feature, the type of sample (grab or composite), and the analytical parameters will dictate the type of equipment used to collect samples.

Surface Grab Samples

Grab samples are collected by immersing the sample container in the water to be sampled (when possible). This eliminates the potential for cross contamination from sampling equipment. To collect a grab sample, perform the applicable steps described below.

1) Planning should be performed to identify the most logical order for sample collection. Sampling from a drainage ditch or stream should begin with background locations, the farthest downstream location, or the location farthest from any suspected contaminant source. This minimizes the potential for cross-contamination or influencing downstream samples by disturbing sediment that can be carried downstream. If samples are being collected from a pond or impoundment, samples farthest from a discharge point or inlet that could be a source of contamination should be collected first.

2) At each sampling location, initiate a sample collection data sheet (developed for the sampling activity) by recording the location number, date, time, and samplers' initials.

3) Calibrate or verify calibration as needed for field instruments (calibration may be performed at the staging area at the beginning of the day). Perform field measurements as designated in the FSP. This will include pH, conductivity, and temperature at a minimum. Other measurements such as OVA/OVM organic vapor readings, radioactivity screening, depth, and/or dissolved oxygen may be designated in the FSP. Record results on the data sheet.

4) Wear new, clean surgical-type gloves to avoid contamination of the sample or container.

5) If the water is deep enough, collect samples by submerging the sample container into the water. Cap immediately, dry the outside of the bottle, and affix a completed sample label.

6) If the water is too shallow to submerge the sample containers, use a decontaminated stainless-steel bucket or Teflon® beaker to collect enough water for all sample containers. Carefully decant the water from the bucket or beaker into the sample containers.

Note: Samples for VOC analysis cannot be collected in this manner; the sample containers must be submerged. Be sure to note any problems or conditions that could cause VOC loss.

An alternative to increase water depth for collecting grab samples is to temporarily dam the streamflow or to dig a shallow depression. Collect samples after the disturbed sediment has cleared.

7) If composite samples are to be collected (for non-volatile parameters only), collect the same volume of water from each location and place in a decontaminated bucket. After all samples are collected, gently mix the water and pour into sample containers as designated for analysis.

8) If samples will be analyzed for dissolved constituents, collect the samples in a bucket or beaker and filter the sample directly into the container. An alternative is to perform filtration at the staging area as soon as possible. In this case, collect a large enough volume of sample to allow for later filtration. Filter the samples into new, clean sample containers.

9) Decontaminate the bucket or beaker by scrubbing with water and detergent, rinsing with potable water, and rinsing with ASTM Type II water. Decontaminate field meters and the measuring tape by the same procedure, followed by rinses with pesticide-grade cyclohexane and methanol and a final rinse with ASTM Type II water after the solvents have evaporated. High-pressure hot water or steam cleaning should also be used on equipment that can withstand it.

10) Collect equipment blanks at the frequency designated in the FSP or QAPP by pouring ASTM Type II water into the bucket or beaker, swirling it gently, and pouring into sample containers.

11) Collect trip blanks if VOC samples are being collected. Trip blanks consist of filled VOC sample containers handled with the other

sample containers and shipped in the same coolers that are not opened until analysis at the laboratory.

Grab Samples at Depth

If samples are being collected at depth from a pond, impoundment, or stream, a Van Dorn or Kemmerer sampler is used. If samples are being collected from a pond or impoundment, a small boat or rubber raft may be needed. If so, follow health and safety procedures for using this type of equipment. Samples are collected as follows:

1) At the sampling location, perform steps 2 through 4 as described above for grab samples.

2) Prepare the sampler by pulling the end caps away from the tube and securing them with the spring-loaded “triggers” as appropriate for the type of sampler.

3) Lower the sampler to the desired depth and release the weighted messenger. The line must be straight and taut so the messenger can properly trip the end caps.

Note: This type of sampler may be accidently tripped by sudden movements, being knocked against other objects, or being lowered too quickly. In some cases, the messenger may not trip the end caps and the sampler will not close. The sampler may need to be lowered to depth repeatedly to collect a sample. Close attention is needed to monitor either of these conditions and ensure that valid samples are collected.

4) Raise the sampler and open one end. Carefully pour the water into designated sample containers. Label samples, complete documentation, and ship samples as required. If filtration is required, pour the sample into a decontaminated bucket for easier use of the filter apparatus.

5) Collect composite samples as described in Step 7 for grab samples.

6) Collect trip and equipment blanks as designated in the FSP or field instructions.

7) Decontaminate the sampling equipment by scrubbing with potable water and detergent, steam cleaning (if equipment is available), rinsing with potable water and ASTM Type II water, rinsing with cyclohexane and methanol, and doing a final rinse with ASTM Type II water after the solvents have evaporated.

Automated Sampling

An automatic sampler may be used to collect individual or composite samples. Samples are collected using this equipment by:

1) Perform steps 2 through 4 as described for grab samples.

2) Set up the automatic sampler and intake port at the designated location and depth. Label and load the sample containers.

3) Program the sampler as described in the operations manual.

4) Begin sample collection; monitor pH, conductivity, and other parameters as required in the FSP.

5) After samples have been collected, filter (if required), complete documentation, and prepare samples for shipment.

6) Dismantle and decontaminate sampler as described in the operations manual.

7) Collect field and trip blanks as designated in the FSP or field instructions.

6.0 RESPONSIBILITIES

The Project Manager is responsible for the management and direction of the entire project including review of the Work Plan (WP), Sampling and Analysis Plan (SAP), Site Specific Health and Safety Plan (SSHSP), project schedule, and budget.

The Field Team Leader is responsible for the following:

- Coordinates and communicates with the Project Manager to ensure the project is performed and completed in accordance with the work plan and the client’s direction.

- Documents the sampling activities implemented to conform with the SAP.

- Ensures that all sampling activities are conducted in accordance with the SSHSP, including the initial coordination with local emergency officials, hospitals, fire departments, etc.

- Directs field staff during all phases of the sampling activities.

- Coordinates with the designated EQ Laboratory Coordinator regarding sample containers, shipment, proper volumes required, turnaround times necessary, follow-up, etc.

Field Technicians are responsible for the following:

- Reading, understanding, and following all project plans.

- Accumulating and dispatching appropriate sampling supplies and equipment to accomplish the sampling objectives.

- Setting up and maintaining onsite sample storage and decontamination areas prior to sample collection.

- Identifying and marking sample points.

- Collecting, preserving, retaining, and packaging all samples, including the physical custody of the samples collected until final preparation and transfer to an onsite lab or shipment to an offsite lab.

- Maintaining detailed sampling records including sample logs, data sheets, and site diagrams/figures.

- Completing and retaining all Chain-of-Custody (COC) forms.

The Quality Assurance Coordinator is responsible for the review and critique of field sampling procedures including sample collection, preservation, preparation, and laboratory services. Additionally, the QA/QC sample frequency (duplicates, blanks, etc.) will be evaluated for conformance to the SAP.

The Health and Safety Officer/Coordinator is responsible for the development of the SSHSP and review of sampling procedures for health and safety concerns.

7.0 EQUIPMENT, MATERIALS, AND SUPPLIES

7.1 Documents

- Work Plan (WP)
- Sampling and Analysis Plan (SAP)
- Site Specific Health and Safety Plan (SSHSP)
- Quality Assurance Plan (QAP), if necessary
- Site Map identifying sampling locations
- Field Log Books including sample log, notebook, etc.
- Pencil, paper, etc.

7.2 Personal Protective Equipment

- As specified in the HASP
- Rain gear and/or warm/cold weather clothing as applicable

7.3 Sampling Equipment

- Water Quality meters
- Bacon bomb
- Bailer, sludge judge, glass thieves/jars
- Kemmerer bottle or equivalent
- Dip-type samplers, pond sampler
- Pumps

7.4 Sample Containers and Materials

- Sample stakes, flags, and/or caution tape
- Sample containers provided by the laboratory including containers for field QA samples (duplicates and rinse blanks)
- Sample container labels
- Permanent marking pens
- Plastic garbage bags for sampling debris, sample coolers, etc.

7.5 QA/QC Materials

- Chain-of-Custody Forms
- Lab Analysis Request Forms
- Overnight Courier paperwork
- Coolers

7.6 Decontamination Supplies

- Scrub-brushes, buckets, tubs, etc.
- Plastic sheeting
- Paper towels and/or Kimwipes
- Alconox detergent
- Water, ASTM Type II
- Nitric acid, hydrochloric acid, and isopropyl alcohol if required
- Containers for generated decontamination liquids

7.7 Miscellaneous Supplies

- Keys to secured areas
- Hip-Waders, boots, safety-rope/chain
- Extendable rod
- Clipboard

- Zip-lock bags
- Refreshments
- Two-way radios and/or cellular telephone
- Camera and film
- Thermometer
- Flashlight and batteries
- Folding table
- Stopwatch
- Toolbox
- Compass
- Calculator
- Tape measure
- Rope/twine
- Other materials/supplies as required

APPENDIX 2

STANDARD FORMS AND LOGS

Sampling Equipment Calibration Log
Air Sampling Data Sheet
Air Sampling Record
Real Time Monitoring Log
Sample Label and Custody Seal
EQ Chain of Custody

SAMPLING EQUIPMENT CALIBRATION LOG

Site Name: ______________________________ Project No.: ____________________

DATE/TIME	INSTRUMENT (Mfg./Model)	CALIBRATED BY	STANDARD (concent.-units)	METER READING	COMMENTS/ AMBIENT CONDITIONS

N:\Forms\Forms\Indexed Forms\Sampling Equipment Calibration Log.wpd

ENVIRONMENTAL QUALITY
MANAGEMENT, INC.

AIR SAMPLING DATA SHEET

Site:

PN ______________________

Date: ______ / ______ / ______

Page: __________ of ______

Sample description/location	Sample number	Pump ID no.	Flow Rate, lpm			Time		Duration, min.	Air volume, liters
			Start	Stop	Avg.	Start	Stop		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
						:	:		
Entries by:	Calculations by:					Checked by:			

Air Sampling Record

Site Name: ______________________ Project No.: ____________________ Date: ____________

Sampled by: ______________________ Sample I.D. No.: ____________________ Personal/Area
(Circle One)

Employee: ______________________ SS No.: ____________________ Shift Time: ____________
(If Applicable)

Location: ______________________________ Indoors/Outdoors
(Circle One)

____

Weather: ______________________________

Activities/Job Title: ______________________ Temp. (°F): ______________________________

______________________________ Humidity: ______________________________

Wind Speed: ______________________________

Controls/PPE: ______________________ Wind Direction: ______________________________

____

Instrument (I.D. No.): ______________________ Start Time: ____________ Start Flow: ____________

Sample Method: ______________________ Stop Time: ____________ Stop Flow: ____________

Agent: ______________________ Run Time: ____________ Flow Rate: ____________

Sample Media: ______________________ Air Vol.: ____________

Calib. Source: ______________________

Comments: ____

____

Analytical Lab: ______________________________ C-O-C No.: ____________________

Analytical Method: ______________________________ Analytical Date: ______________

Date Employee Notified: ____________________ Notified by: ______________________

Other Employees that Results Represent: ______________________________________

____

REAL TIME MONITORING LOG

Project No.: ____________________

Site Name: ____________________

DATE/TIME	SAMPLING LOCATION	INSTRUMENT (Mfg./Model)	MEASURED AGENT	RESULTS ( )	SAMPLED BY	COMMENTS/ ACTIVITIES

QEC

P.O. Box 1160
Beaver, WV 25813
800-255-3950 • 304-255-3900

Quality Environmental Containers

PROJECT NAME

SAMPLE ID	SAMPLE DATE
SAMPLED BY	SAMPLE TIME
PRESERVATIVE	______ GRAB ______ COMPOSITE

ANALYSIS REQUESTED

CUSTODY SEAL

DATE ______________________________

SIGNATURE ______________________________

QEC

Quality Environmental Containers

800-255-3950 • 304-255-3900

1800 Carillon Blvd
Cincinnati, OH 45240
(513) 825-7500

Environmental Quality Management, Inc.
Chain of Custody Record

COC Tracking: **EQ-10000**

Project No.	Project Name				No. of Containers	TESTS
Samplers/Affiliation: *(Print Name and Sign)*				Lab P.O. No:		
Sample ID:	Date	Time	Description/Matrix:	Sample Volume / Comments		

Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Ship To:
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	
Relinquished by: *(Signature)*	Date	Time	Received by: *(Signature)*	Date	Time	Airbill Number

Reporting/QA Requirements:	Turn Around Time (***EXACT DUE DATE***):	Report To:	Chain of Custody Seal Numbers

Distribution: White - Accompanies Shipment Pink - Project Files Yellow - Laboratory File